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JOURNAL OF THE SOCIETY OF ARTS.

No. 1,461.] FRIDAY, NOVEMBER 19, 1880. [VOL. XXIX.

ONE HUNDRED AND TWENTY-SEVENTH SESSION, 1880-81.

Arrangements for the Session.

The First Meeting of the One Hundred and Twenty-Seventh Session of the Society was held on Wednesday, the 17th inst., when the Opening Address was delivered by F. J. BRAMWELL, F.R.S., Chairman of the Council. Previous to Christmas there will be Four Ordinary Meetings, when papers will be read by Mr. J. Comyns Carr, Mr. A. G. Lock, Dr. Alfred Carpenter, and Mr. E. Price Edwards.

Ordinary Meetings.

Wednesday Evenings, at Eight o'clock. For Meetings previous to Christmas :—

NOVEMBER 17.—Opening Meeting of the Session. Address by F. J. BRAMWELL, F.R.S., Chairman of the Council.
NOVEMBER 24.—"The Influence of Barry upon English Art." By J. COMYNS CARR.
DECEMBER 1.—"Causes of Success and Failure in Modern Gold Mining." By A. G. LOCK.
DECEMBER 8.—"London Fogs." By Dr. ALFRED CARPENTER.
DECEMBER 15.—"The Use of Sound for Signals." By E. PRICE EDWARDS, Secretary to the Deputy-Master of the Trinity-house. On this evening Dr. TYNDALL, F.R.S., will preside.

For Meetings after Christmas :—

"The Photophone." By W. H. PREECE, Pres. Soc. Tel. Engineers.
"Buying and Selling; its Nature and its Tools." By Prof. BONAMY PRICE. On this evening Lord ALFRED S. CHURCHILL will preside.
"The Participation of Labour in the Profits of Enterprise." By SEDLEY TAYLOR, M.A., late Fellow of Trinity College, Cambridge.
"The Gold Fields of India." By HYDE CLARKE.
"Flashing Signals for Lighthouses." By Sir WILLIAM THOMSON, F.R.S.
"The Present Condition of the Art of Wood-carving in England." By J. HUNGERFORD POLLEN.
"Five Years' Experience of the Working of the Trade Marks' Registration Acts." By EDMUND JOHNSON.
"Trade Prospects." By STEPHEN BOURNE.
"The Manufacture of Aërated Waters." By T. P. BRUCE WARREN.
"The Compound Air Engine." By Col. F. BEAUMONT, R.E.
"Improvements in the Treatment of Esparto for the Manufacture of Paper." By WILLIAM ARNOT, F.C.S.
"Deep Sea Investigation, and the Apparatus used in it." By J. G. BUCHANAN, F.R.S.E., F.C.S.
"The Discrimination and Artistic Use of Precious Stones." By Prof. A. H. CHURCH, F.C.S.
"The Forests of India." By Sir RICHARD TEMPLE, Bart., K.C.S.I.
"The Tenure and Cultivation of Land in India." By Sir GEORGE CAMPBELL, K.C.S.I., M.P.
"Indian Agriculture." By W. R. ROBERTSON.
"Trade Relations between Great Britain and her Dependencies." By WM. WESTGARTH.

Foreign and Colonial Section.

The meetings of this Section will take place on the following Tuesday Evenings, at Eight o'clock :—
February 1, 22; March 15; April, 5; May 10, 31.

Applied Chemistry and Physics Section.

The meetings of this Section will take place on the following Thursday Evenings, at Eight o'clock :—
January 27; February 24; March 24; April 7, 28; May 26.

Indian Section.

The meetings of this Section will take place on the following Friday Evenings, at Eight o'clock :—
January 21; February 11; March 4, 25; April 29; May 13.

Cantor Lectures.

The First Course will be on "Some Points of Contact between the Scientific and Artistic Aspects of Pottery and Porcelain," by Prof. A. H. CHURCH, F.C.S. Five Lectures.

The Second Course will be on "Watchmaking," by EDWARD RIGG, M.A. Three Lectures.

The Third Course will be on "The Scientific Principles involved in Electric Lighting," by Prof. W. G. ADAMS, F.R.S. Four Lectures.

The Fourth Course will be on "The Art of Lace-making," by ALAN S. COLE. Four Lectures.

The Fifth Course will be on "Colour Blindness and its Influence upon Various Industries," by R. BRUDENELL CARTER, F.R.C.S. Three Lectures.

SYLLABUS OF THE FIRST COURSE.

LECTURE I.—NOVEMBER 22.

Bricks, tiles, terra-cotta, basaltes, and unglazed earthenware in general.

LECTURE II.—NOVEMBER 29.

Vitreous, plumbiferous, boracic, and felspathic glazes and enamels. Iridescent and metallic lustres, and colouring substances.

LECTURE III.—DECEMBER 6.

Stoneware and other wares glazed with salt.

LECTURE IV.—DECEMBER 13.

Soft paste porcelains, European and Oriental.

LECTURE V.—DECEMBER 20.

Hard paste porcelains, Chinese, Japanese, and European.

Juvenile Lectures.

The usual short Course of Lectures adapted for a Juvenile audience will be given by G. J. ROMANES, F.R.S., on "Animal Intelligence." The dates for the lectures will be 29th December and 5th January. The lectures will commence at 7 o'clock. Special tickets will be issued for these lectures.

Proceedings of the Society.

CHARTER.—THE SOCIETY OF ARTS was founded in 1754, and incorporated by Royal Charter in 1847, for "The Encouragement of the Arts, Manufactures, and Commerce of the Country, by bestowing rewards for such productions, inventions, or improvements as tend to the employment of the poor, to the increase of trade, and to the riches and honour of the kingdom; and for meritorious works in the various departments of the Fine Arts; for Discoveries, Inventions, and Improvements in Agriculture, Chemistry, Mechanics, Manufactures, and other useful Arts; for the application of such natural and artificial products, whether of Home, Colonial, or Foreign growth and manufacture, as may appear likely to afford fresh objects of industry, and to increase the trade of the realm by extending the sphere of British commerce; and generally to assist in the advancement, development, and practical application of every department of science in connection with the Arts Manufactures and Commerce of this country."

THE SESSION.—The Session commences in November and ends in June. The number of Meetings held during the Session amounts to between 70 and 80.

ORDINARY MEETINGS.—At the Wednesday Evening Meetings during the Session, papers on subjects relating to inventions, improvements, discoveries, and other matters connected with the Arts, Manufactures, and Commerce of the country are read and discussed.

INDIAN SECTION.—This Section was established in 1869, for the discussion of subjects connected with our Indian Empire. Six or more Meetings are held during the Session.

FOREIGN AND COLONIAL SECTION.—This Section was formed in 1874, under the title of the African Section, for the discussion of subjects connected with the Continent of Africa. It was enlarged, in 1879, so as to include the consideration of subjects connected with our Foreign and Colonial Possessions generally. Six or more Meetings are held during the Session.

APPLIED CHEMISTRY AND PHYSICS SECTION.—This Section was formed in 1874, for the discussion of subjects connected with Practical Chemistry and its application to the Arts and Manufactures. It was enlarged in 1879 so as to include the consideration of subjects connected also with the Applications of Physical Science to the Arts. Six or more Meetings are held during the Session.

CANTOR LECTURES.—These Lectures originated in 1863, with a bequest by the late Dr. Cantor. There are Three or more Courses every Session, and each course consists generally of from Three to Six Lectures.

ADDITIONAL LECTURES.—Special courses of Lectures are occasionally given.

JUVENILE LECTURES.—A short Course of Lectures, suited for a Juvenile audience, is delivered to the Children of Members during the Christmas Holidays.

ADMISSION TO MEETINGS.—Members have the right of attending the above meetings and Lectures. They require no tickets, but are admitted on signing their names. Every Member can admit *two* friends to the Ordinary and Sectional Meetings, and *one* friend to the Cantor and other Lectures. Books of tickets for the purpose are supplied to the Members, but admission can be obtained on the personal introduction of a Member. For the Juvenile Lectures special tickets are issued.

JOURNAL OF THE SOCIETY OF ARTS.—The *Journal*, which is sent free to Members, is published weekly, and contains full Reports of all the Society's Proceedings, as well as a variety of information connected with Arts, Manufactures, and Commerce.

EXAMINATIONS.—The Society's Examinations now comprise the following divisions:—1. Political Economy. 2. Domestic Economy—(*a*) Cooking; (*b*) Clothing; (*c*) Health; (*d*) Housekeeping and Thrift. 3. Music—(*a*) Theory; (*b*) Practice. 4. Elementary. The Programme for 1881 can be had on application to the Secretary.

LIBRARY AND READING-ROOM.—The Library and Reading-room are open to Members, who are also entitled to borrow books.

CONVERSAZIONI are held, to which the Members are invited, each Member receiving a card for himself and a Lady.

Membership.

The Society numbers at present between three and four thousand Members. The Annual Subscription is Two Guineas, or a Life Subscription of Twenty Guineas may be paid.

Every Member whose subscription is not in arrear is entitled:—

To be present at the Evening Meetings of the Society, and to introduce two visitors at such meetings, subject to such special arrangements as the Council may deem necessary to be made from time to time.

To be present and vote at all General Meetings of the Society.

To be present at the Cantor and other Lectures, and to introduce one visitor.

To have personal free admissions to all exhibitions held by the Society at its house in the Adelphi.

To be present at all the Society's *Conversazioni*.

To receive a copy of the Weekly *Journal* published by the Society.

To the use of the Library and Reading-room.

Candidates for Membership are proposed by three Members, one of whom, at least, must sign on personal knowledge; or are nominated by the Council. The Annual Subscription is Two Guineas, payable in advance, and dates from the quarter-day immediately preceding election; or a sum of Twenty Guineas in lieu of all further contributions, may be paid.

All subscriptions should be paid to the Secretary, H. T. Wood, and all Cheques or Post-office Orde should be crossed "Coutts and Company," and forwarded to him at the Society's House, John-stree Adelphi, London, W.C.

Calendar for the Session.

The following is the Calendar for the Session 1880-81. It is issued subject to any necessar alterations:—

NOVEMBER, 1880.		
1	M	
2	Tu	
3	W	
4	Th	
5	F	
6	S	
7	**S**	
8	M	
9	Tu	
10	W	
11	Th	
12	F	
13	S	
14	**S**	
15	M	
16	Tu	
17	W	Ordinary Meeting. (Opening Meeting of the Session.)
18	Th	
19	F	
20	S	
21	**S**	
22	M	Cantor Lecture I. 1
23	Tu	
24	W	Ordinary Meeting
25	Th	
26	F	
27	S	
28	**S**	
29	M	Cantor Lecture I. 2
30	Tu	

DECEMBER, 1880.		
1	W	Ordinary Meeting
2	Th	
3	F	
4	S	
5	**S**	
6	M	Cantor Lecture I. 3
7	Tu	
8	W	Ordinary Meeting
9	Th	
10	F	
11	S	
12	**S**	
13	M	Cantor Lecture I. 4
14	Tu	
15	W	Ordinary Meeting
16	Th	
17	F	
18	S	
19	**S**	
20	M	Cantor Lecture I. 5
21	Tu	
22	W	
23	Th	
24	F	
25	S	Christmas Day
26	**S**	
27	M	Bank Holiday
28	Tu	
29	W	Juvenile Lecture 1
30	Th	
31	F	

JANUARY, 1881.		
1	S	
2	**S**	
3	M	
4	Tu	
5	W	Juvenile Lecture 2
6	Th	
7	F	
8	S	
9	**S**	
10	M	
11	Tu	
12	W	Ordinary Meeting
13	Th	
14	F	
15	S	
16	**S**	
17	M	
18	Tu	
19	W	Ordinary Meeting
20	Th	
21	F	Indian Meeting
22	S	
23	**S**	
24	M	
25	Tu	
26	W	Ordinary Meeting
27	Th	Chem. & Phys. Meet.
28	F	
29	S	
30	**S**	
31	M	

FEBRUARY, 1881.		
1	Tu	For. & Col. Meet.
2	W	Ordinary Meeting
3	Th	
4	F	
5	S	
6	**S**	
7	M	Cantor Lecture II. 1
8	Tu	
9	W	Ordinary Meeting
10	Th	
11	F	Indian Meeting
12	S	
13	**S**	
14	M	Cantor Lecture II. 2
15	Tu	
16	W	Ordinary Meeting
17	Th	
18	F	
19	S	
20	**S**	
21	M	Cantor Lecture II. 3
22	Tu	For. & Col. Meet.
23	W	Ordinary Meeting
24	Th	Chem. & Phys. Meet.
25	F	
26	S	
27	**S**	
28	M	

MARCH, 1881.		
1	Tu	
2	W	Ordinary Meeting
3	Th	
4	F	Indian Meeting
5	S	
6	**S**	
7	M	Cantor Lecture III. 1
8	Tu	
9	W	Ordinary Meeting
10	Th	
11	F	
12	S	
13	**S**	
14	M	Cantor Lecture III. 2
15	Tu	For. & Col. Meet.
16	W	Ordinary Meeting
17	Th	
18	F	
19	S	
20	**S**	
21	M	Cantor Lecture III. 3
22	Tu	
23	W	Ordinary Meeting
24	Th	Chem. & Phys. Meet.
25	F	Indian Meeting
26	S	
27	**S**	
28	M	Cantor Lecture III. 4
29	Tu	
30	W	Ordinary Meeting
31	Th	

APRIL, 1881.		
1	F	
2	S	
3	**S**	
4	M	Cantor Lecture IV. 1
5	Tu	For. & Col. Meet.
6	W	Ordinary Meeting
7	Th	Chem. & Phys. Meet.
8	F	
9	S	
10	**S**	
11	M	Cantor Lecture IV. 2
12	Tu	
13	W	
14	Th	
15	F	Good Friday.
16	S	
17	**S**	Easter Sunday
18	M	Bank Holiday
19	Tu	
20	W	
21	Th	
22	F	
23	S	
24	**S**	
25	M	
26	Tu	
27	W	Ordinary Meeting
28	Th	Chem. & Phys. Meet.
29	F	Indian Meeting
30	S	

MAY, 1881.		
1	**S**	
2	M	Cantor Lecture IV. 3
3	Tu	
4	W	Ordinary Meeting
5	Th	
6	F	
7	S	
8	**S**	
9	M	Cantor Lecture IV. 4
10	Tu	For. & Col. Meet.
11	W	Ordinary Meeting
12	Th	
13	F	Indian Meeting
14	S	
15	**S**	
16	M	Cantor Lecture V. 1
17	Tu	
18	W	Ordinary Meeting
19	Th	
20	F	
21	S	
22	**S**	
23	M	Cantor Lecture V. 2
24	Tu	
25	W	Ordinary Meeting
26	Th	Chem. & Phys. Meet.
27	F	
28	S	
29	**S**	
30	M	Cantor Lecture V. 3
31	Tu	For. & Col. Meet.

JUNE, 1881.		
1	W	
2	Th	
3	F	
4	S	
5	**S**	Whit-Sunday
6	M	Bank Holiday
7	Tu	
8	W	
9	Th	
10	F	
11	S	
12	**S**	
13	M	
14	Tu	
15	W	
16	Th	
17	F	
18	S	
19	**S**	
20	M	
21	Tu	
22	W	Conversazione at the South Kensington Museum
23	Th	
24	F	
25	S	
26	**S**	
27	M	
28	Tu	
29	W	Annual General Meeting
30	Th	

The chair will be taken at eight o'clock at each of the above meetings, except the Annual Genera Meeting.

The Annual General Meeting will be held at four o'clock.

NOTICES.

THE PHOTOPHONE.

The paper on "The Photophone," by Mr. W. H. Preece, Pres. Soc. Tel. Engineers, announced for reading on the 1st December, has been unavoidably postponed until after Christmas. Mr. Alfred Lock's paper on the "Causes of Success and Failure in Modern Gold Mining," will be read in its place on that day.

INDIAN SECTION COMMITTEE.

A meeting of the Committee of the Indian Section, was held on Monday, 15th inst, at 4 p.m., Present:—Mr. Andrew Cassels (in the chair), Dr. Birdwood, C.S.I., Sir George Campbell, K.C.S.I., M.P., Lord Alfred S. Churchill, Sir William Rose Robinson, K.C.S.I., Mr. J. T. Wood, with Mr. H. Trueman Wood, Secretary, and Colonel Hardy, Secretary of the Section. The programme of papers to be read during the present session was discussed and decided upon.

PROCEEDINGS OF THE SOCIETY.

FIRST ORDINARY MEETING.

Wednesday, November 17th, 1880; F. J. BRAMWELL, F.R.S., Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Allcock, Arthur Thomas, 5, Spring-gardens, Newark-upon-Trent.
Atkinson, Frederick William, 137, Leadenhall-street, E.C.
Aylmer, Capt. John Evans-Freke, M.P., Aylmersfield, Streatham.
Baillie, J. H., 15, Old Bond-street, W.
Baxter, F., South Eastern-wharf, Park-street, S.E.
Bell, R., 83, Knightrider-street, E.C.
Bennet, Peter Duckworth, Edgbaston, Birmingham.
Biggs, Benjamin, 3. Lawrence Pountney-hill, E.C.
Blackwood, Richard, 96, Cromwell-road, South Kensington, S.W.
Blamires, Thomas Howard, Close-hill, Lockwood, near Huddersfield.
Blyth, James, 31, Park-terrace, Regent's-park, N.W.
Capel, Frank C., The Mount, Wilmington, Kent.
Carpmael, Alfred, 1, Copthall-buildings, E.C.
Clark, William Timbrell, Kilsby, near Rugby.
Collington, James B., Beeston, Nottinghamshire.
Comerma, Capt. Andrés A., 48, Macfarlane-road, Shepherd's-bush, W.
Cottew, William Stokes, The Bank, Tottenham.
Cranwell, William B., 42, Portsdown-road, W.
Crookenden, Isaac Adolphus, Marlborough-house, Blackheath, S.E.
Deane, James Parker, D.C.L., Q.C., 3, Paper-buildings, Temple, E.C., and 16, Westbourne-terrace, W.
Deaville, Rev. Joseph Gibson, Agincourt-villa, Bury, Lancashire.
Dewrance, John, 176, Great Dover-street, S.E.
Eaton, Francis James, Albert-road, Hesketh-park, Southport, Lancashire.
Emptage, Daniel, Dane-hill Sanitary Works, Margate.
Estcourt, R. M., Local Government Board, S.W.
Evans, Lieut.-Colonel John, Highfield, Derby.
Ford, George Benjamin, 196, Westminster-bridge-road, S.E., and 9, Cuthill-road, Denmark-hill, S.E.
Freeman, William George, 44, Kensington-square, W.
Gordon, C. A., M.D., C.B., 70, Cambridge-gardens, W.
Grant, Sir John Peter, K.C.B., G.C.M.G., The Doune of Rothiemurchus, Aviemore, N.B.
Greenall, Lieut.-Colonel James Fenton, Lingholme, Derwentwater, Cumberland.
Guest, Montague J., M.P., 3, Savile-row, W., and Bere Regis, Blandford, Dorset.
Guthrie, Herbert, 32, Brown-street, Manchester.
Hall, Alexander Lyons, F.R.G.S., Lyon's-court, Ladbroke-road, Holland-park, W.
Harper, George Thomas, Southampton.
Harvey, William Charles, 12, Old-square, Lincoln's-inn, W.C., and 8, Warwick-road, Maida-hill West, W.
Haynes, F., Superintendent's Office, Telegraph Department, G.W.R., Taunton.
Heyworth, Lieut.-Colonel Lawrence, Wain Vawr, near Newport, Monmouth.
Hickman, Alfred, Goldthorn-hill, near Wolverhampton.
Homan, Ebenezer, Friern Watch, Finchley, N.
Hulse, Joseph, Dresden, Longton, Staffordshire.
Isaac, Benjamin, 102, Piccadilly, W.
Johnson, Walter Claude, Rivoli, Old Charlton, Kent.
Judson, Frederick Henry, 77, Southwark-street, S.E.
Keyser, Charles Edward, M.A., F.S.A., Merry-hill-house, Bushey, Herts.
Lambe, J. B., 199, Upper Thames-street, E.C., and 427, New-cross-road, S.E.
Lightfoot, Thomas Bell, 2, Granville-park, Blackheath, S.E.
Lingard-Monk, Richard Boughey Monk, 4, Westminster-chambers, S.W., and Fulshaw-hall, Wilmslow, Cheshire.
Lovell, Richard J., 48, Oakley-road, Canonbury, N.
McDonald, James E., 4, Chapel-street, Cripplegate, E.C.
Marriner, William Tyler, Eton-villa, King Edward's-road, South Hackney, E.
Marshall, Alfred, The Villa, Muswell-hill, N.
Martin, John Cowdery, White Lead Works, Ossory-road, Old Kent-road, S.E.
Mineard, George Edward, 57, Warwick-road, South Kensington, S.W.
Moser, Charles E. Brooklyn, 75, Upper Tulse-hill, S.W.
Neal, James, 21, Lime-street, E.C.
Nyland, James, 42, Burlington-road, St. Stephen's-square, Bayswater, W.
Paddon, Samuel Wreford, Brooklyn, Chislehurst.
Pearson, Joseph Hickman, J.P., The Leveretts, Handsworth, near Birmingham.
Pfoundes, Charles, 1, Cleveland-row, St. James's, S.W.
Pickering, Charles William Harrison, J.P., New Brighton, Cheshire.
Pinnock, Henry, J.P., Beechwood, Newport, Isle of Wight.
Pursell, John Roger, Kingston-road, Merton, Surrey.
Puzey, William, 5, Aldermanbury-postern, E.C.
Quincey, Edmund de Quincey, 76, Avenue-road, Regent's-park, N.W.
Ravenscroft, Sidney Horace, Powis-lodge, Haverstock-hill, N.W.
Robinson, John, F.G.S., Kingscote, East Grinstead.
Robson, John, Tynemouth-road, The Green, Tottenham.
Rogers, J. H., Llanelly, Carmarthenshire.

Rothwell, Richard, 45, Holland road, Kensington, W.
Rudd, William Albert, Gloucester-house School Science and Art Classes, Dodington, near Sittingbourne.
Simpson, George Palgrave, 2, Mount-terrace, Richmond, Surrey.
Sonnenthal, George, 85, Queen Victoria-street, E.C.
Southee, Arthur Philip, Mount Edgecumbe, Ramsgate.
Squire, John Barret, Worston-house, Durning-road, Liverpool.
Stanger, George Hurst, Queen's-chambers, North-street, Wolverhampton.
Stone, James Henry, J.P., Cavendish-house, Grosvenor-road, Handsworth, Birmingham.
Tarr, William, 83, Knightrider-street, E.C., and Ferndale, Walton-on-Thames.
Trench, Lieut.-Colonel the Hon. William Le Poer, 3, Hyde-park-gardens, W.
Verity, John, 31, King-street, Covent-garden, W.C.
Warrick, Robert Betson, 27, Woburn-square, W.C.
Weager, W. H., 26, Leadenhall-street, E.C., and Tottenham.
Weir, James, 49, Jamaica-street, Glasgow.
Wells, Charles A., 1, High-street, Lewes, Sussex.
Wing, John Unwin, Brinkburn-grange, Sheffield.
Wyatt, Vitruvius, Gas Light and Coke Company, Beckton, E.
Ziegler, David, 7, Upper Woodland-terrace, New Charlton, Kent.

The Chairman delivered the following—

ADDRESS.

As no doubt most of you are aware, the By-laws of this Society make it necessary for the Chairman of the Council to retire from office after he has served for two years, and render him ineligible for re-assuming the chair until he has been away therefrom for at least one year. And thus it is, that we are deprived of the advantage of the chairmanship of Lord Alfred Churchill, who has so ably discharged, during the last two years, and on previous occasions, the duty of presiding over your Council. I am sure that, expedient as the By-law is, looked upon as a general law, applicable therefore to all, those who fully know, as the members of Council do know, the valuable services Lord Alfred Churchill has rendered to this Society by his assiduous attention to his duties, and by the high intelligence and extreme courtesy which he manifested in the discharge of them, will regret that, in his instance at least, the obligatory retirement enforced by the By-laws could not have been waived, so that we might have been able to say, "Oh, Chairman, reign for ever." Among all the members of this Society, none would have uttered that wish with more earnestness and with more sincerity than the member who now addresses you. But our laws, like those of the Medes and Persians, are inflexible in their application, and so it befel that, at the end of last Session, the chair became vacant.

I have received, from my colleagues on the Council, the unexpected honour of being selected as the successor to Lord Alfred Churchill, and thus it happens I have before me the task of addressing you on the opening evening of the Session 1880-81. I find in the performance of such a duty great difficulty, but being a duty, and one imposed by the By-laws, it must be fulfilled, and I will, therefore, without further preface than that of bespeaking your kind indulgence, proceed to discharge my task.

Your late Chairman, in one of his addresses, reminded you that when, in 1754 (126 years ago), this Society was founded, there existed none other which took cognisance of Arts, Manufactures, and Commerce. The Royal Society, established in 1660, was then, as now, engaged in the cultivation of pure science; and, indeed, it was not until some years after your foundation that Smeaton, the civil engineer, and a Fellow of the Royal Society, finding the need of an institution dealing with the application of science, originated that society of civil engineers now known as the "Smeatonians," a society which, from the first, was devoted to social purposes as well as to the discussion of engineering subjects; it is in the former capacity alone that it at present exists, having for its president of this year the engineer who is now Chairman of your Council.

Very different is the condition of things at this time. Institutions and societies abound on all hands. Indeed, it would be difficult to find a profession, or, in fact, an industry, which has not its own special society, or even, as in the case of the engineer, several societies. Civil engineering, in its wide and comprehensive aspect, is represented by the Institution of Civil Engineers, but branches of civil engineering have their separate societies—the Mechanical Engineers, the Naval Architects, the Telegraph Engineers, Mining Engineers, and others. Then we have the Institute of Architects, we have the Chemical Society, and more recently the Institute of Chemistry; and, in conclusion of this imperfect abstract of the list of learned societies, we have the comprehensive British Association. Among industrial societies, we have the Iron and Steel Institute, the Royal Agricultural Society, and others, not to speak of Chambers of Commerce. Not only has each profession its special society, but commonly also its own peculiar literature, such as journals devoted to engineering, to architecture, to medicine, and to chemistry. The industries likewise have their special literature; we have such papers as the *Miller*, the *Draper*, the *Jeweller and Metal Worker*, and I am told that there is a journal devoted to the profession or trade —I not know which to call it—of the pawnbroker.

You may remember that a late popular author took exception to the parade of system in the business of the publican, and, complaining of the inscriptions of "wholesale department," "retail department," and "jug and bottle department," suggested that the time would come when the subdivision would be still further extended, so that we should see written up "whisky bell" and "brandy entrance." I must confess I have a somewhat similar apprehension about the multiplication of societies for the consideration of branches of a profession; and I feel the day may come when there will be an institution for the civil engineering of piers, another for lighthouses, a third for docks, and a fourth for iron girder bridges. Up to a certain point, separate societies for branches of a profession, such as that of the Naval Architects, and of other already cited institutions as existing for branches of civil engineering, may be of advantage; but it is easy to carry the system of separation so far as to imperil the acquisition of the general knowledge of his particular profession as a whole, which a thoroughly competent professional man should possess.

But without speculating further as to the future development of special societies, it is clear a sufficient number already exist to give occasion to some among the outside public, who have not been at the pains to consider the subject, to ask what is now the necessity for a Society of Arts? What functions remain to it in relation to Arts, Manufactures, and Commerce? Do not the special societies cover all the ground, and are they not, being special, in a better position to do good work, each in its own line, than can be done by a society like yours, which has no speciality? Such suggestions, adverse to our continued utility, may find favour on a first hearing among those who do not know the working of our Society, and who will not be at the pains to learn what that working is, before they come to a determination in their own minds upon the question, but we, the members, know better. We are aware that there is a very wide field for the work of this Society—a field unoccupied, and of necessity unoccupied, by the special societies which have sprung up. For instance, we must all agree it is for the good of the country at large that men and women, wholly unconnected with particular industries, except (and it is a most important exception) in their capacities of consumers, should have a general knowledge of how those things they consume are produced. I will ask how, without the existence of the Society of Arts or of some kindred society, would it be possible for this large section of the public to obtain such general knowledge. By the hypothesis, these persons are not specialists, and, therefore, they are not eligible as members of these special societies. Moreover, in the comparatively rare cases, where a man is eligible for membership of one society, he cannot be eligible for membership of all; and, further, if a non-specialist attend the meetings of a special society, he will find in all probability that its deliberations are not relating to broad generalities, such as the non-specialist wants to hear discussed, but that they are concerned, and properly so, with considerations of detail—of those details which may appear of but small value to the ordinary hearer, even if he can understand them, but to the patient accumulation of which the improvement in an art is much more commonly due than it is to some one great discovery.

At our meetings, as I have said, the audience profit by having presented to them, in a comprehensive and intelligible form, the leading facts connected with our important industries, thereby the range of knowledge of all is increased and interest is excited; moreover, this very important end is attained, that those who are thus instructed become intelligent purchasers, a desirable result not only for those who purchase, but for those who manufacture, since the intelligence of the purchaser raises the standard of the manufacture. I will refer to a recent instance, that of the admirable course of Cantor Lectures delivered here by Mr. Bolas on the "India-rubber and Gutta-percha Industries." I do not hesitate to affirm that the hundreds who heard those lectures, and the thousands who read them in our *Journal*, became thereby discriminating purchasers, to their own benefit and to the benefit of the honest producer.

At the risk of being open to the charge of quoting myself, in remarks I delivered in this room some years ago, upon the Patent-law, I must point out another, and, to my mind, a very important particular, in which the bringing the processes of manufacture before persons not having any special knowledge thereof is useful, and that is the aid afforded to substantive invention. By substantive invention, I mean an invention which changes fundamentally the process of a manufacture, as distinguished from inventions of improvement in detail in the manufacture as hitherto carried on. Those who are imbued with a specialist's knowledge have a difficulty in taking a thoroughly new view of a manufacture; paradoxical as it is, they are encumbered with their own too intimate knowledge of every existing step and detail. In the paper on the Patent-law, to which I have alluded, I gave certain instances of well-known substantive inventions, all of which had been made by men having no previous connection with the industries to which those inventions related. I will not take up your time by repeating any of them here, but I will, with your permission, give the following instance—an instance that has come to my knowledge since the date of that paper. Fortunately, in the interests alike of the makers and the wearers of boots and shoes, a certain inventor, when he set himself to invent a machine for sewing on the soles of boots and shoes, had no previous knowledge of the manufacture, except that wherein rivets were used. He knew what an ordinary sewing machine was like, and he, of course, knew the outward appearance of a sewn boot. Luckily, as I have said, he had not studied that part of the shoemaker's art which related to the attachment of the sole by sewing. It occurred to this inventor that it would be a very desirable thing if a sewing machine could be made so compact that the necessary working parts could be introduced up the leg of a boot, and to the very extremity of its toe, and, when there, could be driven in the needed and imperative unison with the machinery exterior to the boot. The inventor solved the problem, and made a machine, the necessary portion of which could be inserted into the toe of a boot, and could be worked there, but this machine would not have been of the slightest use in sewing a sole to a boot in the manner in which that operation had up to that time been conducted by hand, although it was of every use in the sewing on of a sole by the process which the inventor, in his happy ignorance, believed to be followed.

In the ordinary hand-made boot, the upper leather is not fastened to the sole directly, but has sewn to it a bevelled strip on each side, which is called the "welt." It is this welt, and not the upper leather, which is united to the sole, and thus, although the hand cannot be got to work within the boot, the union of the upper leather to the sole is effected through the medium of the welt. The inventor, however, considering the whole subject with an untrammelled mind, assumed that the reasonable way to secure the upper leather to the sole was to do so directly, and without any go-between. Now, everybody who knew the art and mystery of shoemaking had a trammelled mind, he had it engrained in his very being, that in all cases where thick and comparatively rigid soles were sewn on, welts were indispensable. I will ask you to imagine to yourselves the impediment that this reverence for the welt must have

been in the way of any man thoroughly understanding the shoemaking business, and endeavouring to use sewing machines for the purpose of attaching the sole to the upper leather. Such a one would get as far as the sewing of the welt to the upper leather by machinery but there he would be stopped from any attempt to devise a machine to work within the boot, and for the very obvious reason, that having sewn on the welt, he would, of course, use that welt for the purpose for which he had sewn it on, namely, that of effecting the union of the upper leather to the sole by stitches, not from within the boot at all, but entirely external thereto. I have seen the evidence which the inventor prepared to offer before the Privy Council, and he there declares that had he known the details of the way in which the upper leather is sewn on to the sole, he would never have ventured to solve the problem. The inventor, of whom I have hitherto been anonymously speaking, is Mr. Blake, an American, and I was informed only yesterday, through the representative of the Blake Company, that one hundred millions of pairs of boots and shoes were sewn last year on the Blake machines. I have devoted, I fear, to the subject of boot-sole sewing machines too large a proportion of the total time allotted for this address; but I have been induced to do so because I believe the circumstances I have narrated afford a fair instance of the benefit which invention derives from the attention of intelligent non-specialists being directed to the broad and general features of a manufacture, in the way in which it is directed in the papers and lectures read and delivered within this room.

Another use of our Society is this—we afford an appreciative home to new arts and industries. The Royal Academy itself, which was founded in 1768, owes its inception to the first exhibition ever made of the pictures of British artists in 1760, and repeated in following years, in the rooms of the Society of Arts. Again, in 1852, photography came to us as a new-born art, and one without a home; that foundling was taken in by the Society of Arts, and, being nourished, has grown up to vigorous manhood. We will hope that invention and discovery are not at an end, and that, from time to time, new arts and industries will arise. As they come into existence, it is all but certain they will need shelter and encouragement, and sure I am that so long as this Society is to the fore, those needs will not remain unsatisfied.

Without taking up your time by further specific instances of the way in which our Society has a right to its place, notwithstanding that there are so many special societies and institutions, I may refer objectors to the answer contained in the old saying, "That there is nothing so successful as success," and if they dared to dispute our being successful, they would certainly be defeated. We can point to the fact that we number over three thousand members, that we have institutions all over the country in union with us, that we publish a weekly *Journal*, circulated gratuitously among those members and institutions, by which they and the public at large are kept fully informed of the condition and progress of our leading manufactures, that we have been fortunate enough to be favoured with the recognition of the Prince of Wales, who honours us by being our President, and that we succeed in obtaining in the guidance of our work the untiring assistance at the Council of men eminent in the most varied ways.

With respect to the work we do, some of our critics say that we occasionally, indeed not unfrequently, occupy ourselves with matters which, wide as is the scope of the Society's operations, as stated in our Charter, cannot be brought properly within the pale of Arts, Manufactures, or Commerce. For instance, the Society takes up Drill. They say if drill mean a certain textile fabric commonly used for male garments, well and good; if it mean the implement for making holes, either in the soil or in metals, equally well and equally good; but if it mean, as in truth it does, the training to which soldiers are subjected, how, by any possibility, can that drill be connected with arts, manufactures, or commerce? What have "shoulder arms," to do with arts? "Right about face," with manufactures, or "quick march," with commerce? "Shoulder arms" suggests hard angularity, and nothing in connection with arts, or art; "Right about face" is opposed to the steady and forward progress that should be made in manufactures; and "Quick march" is more applicable to mere speculation, than to the sound prosecution and regular progression of legitimate commerce. Apparently valid objections these, but see how they disappear before the explanation given by the advocates of drill. They say, to have excellent manufactures, you must have excellent workmen—you must cultivate not only their minds, but also their bodies. You want manly men, men whose powers are developed, and who are trained to apply those developed powers in the best manner. An excellent means to this end is in early life to give the training of drill, resulting in that which we all know as a soldierly bearing; a lad who has once acquired this will hardly ever in after life entirely lose it, but he will go about erect, self-reliant, and self-respecting, and for the whole of his life will be a better man than one who, undrilled, slouches through existence. Should the critics still be dissatisfied, and say the link you show between drill and manufactures is too slender, the argument is more ingenious than sound, and should they urge that public bodies ought to keep more rigidly to the undoubted objects for which they were incorporated, the supporters of drill can refer to a precedent of very high authority—a precedent which, with your permission, I will quote to you. In a certain island, the latitude of which I will not state, and the longitude of which I cannot state, because to the English mind it is of no longitude, there were established in years gone by, three principal Courts of law, the names of which, curiously enough, may be not unfamiliar to you. The first was called the King's Bench; it took cognisance of affairs affecting the dignity and peace of their lord, the king. The second was called the Court of Exchequer. This Court took cognisance of all matters affecting the king's revenue. The third Court was called the Common Pleas, and it took cognisance of plaints between subject and subject. While the population was scanty and rude, business transactions were but few, and the Court of Common Pleas was the least occupied of the three; but, as time went

on, the people increased in number and in wealth, and became more civilised. Offences against the king's peace, and frauds upon his revenue, happily for the public, diminished in number, while business developed, and, as a result, transactions became complicated, and plaints between subject and subject grew and multiplied. The Court of Common Pleas naturally was in a very flourishing condition, and those connected with it throve upon the fees paid by the suitors; but the Courts of King's Bench and Exchequer, although they retained their dignity, found themselves excluded from the pecuniary benefits enjoyed by the Common Pleas. This went on until an ingenious member of the Court of Exchequer, prompted by necessity, found the connecting link by which that Court was enabled, of course strictly within its functions of guarding the king's revenue, to take cognisance of plaints between subject and subject. The link was this. Subject A should pay the king his taxes, but if subject B did not pay to A the money which B owed to him, A obviously would not be likely to pay the taxes to the king, thereupon, quite within its province of course, it became incumbent on the Court of Exchequer to ascertain whether B did owe A a sum of money, and thus the Court of Exchequer investigated plaints between subject and subject. The unhappy King's Bench, however, was still left out in the cold, a cold by comparison all the more disagreeable to bear because its colleague, the Court of Exchequer, had succeeded in withdrawing itself into a comfortable shelter. At length the genius needful to supply the connecting link for the Court of King's Bench was found. That Court, you will remember, took cognisance of all matters affecting the king's dignity and peace. Said the ingenious man of the Court of King's Bench, I know nothing much more likely to cause a breach of the peace than the refusal to pay a just debt. If B owes A money, but will not pay A, such is the infirmity of human nature that A is very likely to cudgel B at the first convenient opportunity. To prevent this breach of the King's peace, it is clearly the duty of the Court of King's Bench, and strictly within its functions, of course, to take cognisance of the plaint between subject A and subject B. Whether this tale is a strictly true one, or whether it has only a foundation of truth, and that as regards its details the Islander from whom I received it was imposing on my credulity, I won't pretend to say, but it seemed to me not wholly inapplicable to the subject we were considering, and that the advocates in the Society of Arts for the promotion of drill, if they can't convince by their argument, may, at all events, crush their opponents by the weight of the precedent I have just quoted.

Having regard to the undoubtedly wide scope afforded us by our Charter, and to the probable increase of that width by ingenious reasoning and by precedent such as I have cited, you can well understand that there are very few subjects indeed in respect of which a connection with the purposes of this Society may not be traced, or, at least, imagined; and thus it is that your Council have to exercise great discrimination in the acceptance or non-acceptance of the various suggestions that are made to it, as affording proper subjects for the action of the Society. Brown would have all our energies devoted to the obtaining of a soft water supply for the kingdom at large; millions of money would be saved in soap, and millions more in tea. Jones is convinced that water supply is indeed the only fit subject for the Society, but urges that the water must be hard if we desire to avoid lead poisoning—if we wish for a delicate cup of tea instead of a dark and bitter family brew, and above all, if we desire to see the rising generation furnished with bones, and are not content that they should be simply cartilaginous animals. Robinson believes that the true present work of the Society is to see that all sewage is disposed of by irrigation; while Smith, although agreeing that the disposal of the sewage is the only true work, is clear that irrigation is but another name for the spread of disease, and that salvation lies in precipitation. Others would have the Society neglect everything until it had achieved the introduction of the decimal system, and of the French metrical system in particular. Government must come to the rescue. Decimals must be obligatory. They would have no half measures; I beg their pardon, no nought decimal five measures; they would show no quarter—again I err from the right way, I mean, of course, no nought decimal two five—to those who dare to use that complex term, one-third, instead of the simple and nearly accurate expression, nought decimal three three three and a little dash in the right-hand corner; still less would they forgive those who employ, in describing the division of anything into seven equal parts, the wholly unintelligible and cumbrous one-seventh, instead of the concise and elegant (and again nearly accurate) nought decimal one four two eight five seven, and again the little dash in the right-hand corner. The foregoing are but instances—instances of demands which may come from the outside public, from the members of the Society, or, I speak it with reverence, even from the members of the Council itself. Probably some of us have now, as people had in Mr. Shandy's time, our little hobbies on which we would fain disport ourselves; but, happily for the Society, we are not allowed to do so, unless the hobby is proved to be discreet and trustworthy. The check to our vagaries is this: our Council, as I have told you, is composed of men of varied pursuits, the soldier, the legislator, the sailor, the engineer, the chemist, the physician, the Government official, the potter—emphatically *the* potter, for I allude to our friend Mr. Doulton, to whom we owe a new art industry, of which England is justly proud—and many others, go to make up your Council. And though, as I have said, some of these, including, it may be, their chairman, have each his own little hobby, in the sure-footedness of which he implicitly believes, he is not thereby rendered incapable of perceiving the defects in his neighbour's favourite steed. All banter apart, your Council is well attended by men of divers qualifications, and no plan brought before that Council is made the subject of the action of the Society, unless the plan, after thorough scrutiny, commends itself to the good opinion of the majority. Care has also to be exercised in the acceptance of papers, to ensure that not only shall the subjects be of sufficient interest in themselves, but that they are free from any

suspicion of partisanship, or of trade puff. In this work, as indeed in all other matters, the Council are greatly aided by our most attentive and careful secretary, Mr. Trueman Wood, whose connection with this Society, first as assistant secretary to our late and valued friend Mr. Le Neve Foster, and since his death, as secretary, has now subsisted for eight years. On the whole, looking at the innumerable temptations there are to stray, I think the Society is to be congratulated on having kept very fairly within its proper boundaries, and I know I am safe in assuring you that no pains will be spared by your Council, nor will any amount of time and attention be grudged to ensure that good and useful work shall continue to be done.

Thus far, I have been reviewing some of the past action of the Society, and, in doing so, I have have had of necessity to bring to my own recollection the nature of many propositions laid before the Council by ardent persons, but properly rejected as being visionary, or as not within our true functions. And such recollections have tempted me here and there to stray too far from the sedateness that has characterised, and that some of you will think ought always to characterise, the annual address. I fear it will be said that if there be some grains of valuable truth to be found in that which I have laid before you, these grains are very deeply concealed beneath the husk, not to say chaff, with which they are intermingled and overlaid. In considering, however, the future work of the Society which I am now about to do, I find no temptation thus to stray from strict decorum, because I feel that to that future work we ought to devote our best efforts and most grave attention, and because I have to bring before your notice much that is painful and humiliating.

However laudable are those efforts of the Society for the promotion of subjects which have not an immediate, but only a remote bearing on the welfare of Arts, Manufactures, and Commerce, I, for one, am better pleased when I find we are occupied with subjects which do undoubtedly directly and obviously bear upon that welfare; and I am sorry to say that there is an ample field for such occupation in the present condition of our manufactures.

Many of you have, no doubt, read the address delivered at the summer meeting of the Mechanical Engineers by the President, Mr. E. A. Cowper. In that address, Mr. Cowper gives instances of the way in which foreigners not only compete, and rival the manufacturers of this country, but surpass them and outstrip them, and it is to this question I desire now to direct our thought. I am aware this is not a pleasant subject. I should have been glad indeed, if, on the first night of our Session, I could have followed many of my predecessors, by talking to you of progress and of success. Depend upon it, it is more agreeable to the occupant of this chair to prophesy pleasant things, than it is to prophesy evil things, but, nevertheless, there can be no doubt which of these two courses is that of duty, and that course, and not the other, is the one that must be followed.

With respect to this question of being beaten by our rivals, very varying feelings are excited as we consider the circumstances attendant upon our defeat in each particular case; for instance, we do not even regret that an industry, which is an exotic, and not natural to the country, fails us, and reverts to its more proper home. As an extreme example, it is recorded that, long ago, it is true, wine was made from a vineyard on Tower-hill. No one, I presume, seriously laments that efforts have not been made to continue such an industry as this in England. We are well content that it should depart to countries possessing a more genial climate than that in which we live.

We do regret, and complain, but we do not feel ashamed, when an industry, properly within our province, is caused to wither by the mistaken action of the Government of another country, in pampering such an industry within that country by bounties and premiums, against which our manufacturers cannot contend. We are not ashamed of being beaten under these circumstances, but do our best by protest, and, by all means short of a retaliative duty, to put a stop to so mischievous a procedure. But we lament, and that with a mixture of shame, when we find that, in the absence of any such adverse influence as that arising from bounties in foreign countries, industries which are thoroughly adapted to the climate and the soil, and, worse than this, industries which should, from our natural advantages, be specially our own, are carried on in foreign countries in a manner not only to rival us in these countries themselves, and in the markets abroad, but so as actually to successfully compete with us on our own shores. Surely in iron and in steel manufacture, intimately connected as the success of these manufactures is with the cheapness of fuel, we ought to be able to defy competition in any open market, and yet we know that large quantities of girder iron are habitually imported into this country from Belgium. This importation of iron from Belgium is but one instance; it is, I regret to say, by no means a solitary one. Surely there must be something wrong in our conduct of manufacture, when such a state of things can exist, and I believe the Society of Arts will do well to endeavour to ascertain what this something wrong is, and having ascertained, it will do well to set itself to endeavour to find a remedy for the wrong.

I will not venture to predict what would be the result of investigation into the causes of this condition of things, but one can imagine we shall find higher rates of wages operating in some cases, but certainly not operating in those instances where we are beaten out of our own markets by American manufacturers, for in that country, undoubtedly, wages are higher, as a rule, than they are with us, and there are three thousand miles of transport needed to bring the manufactured article to our doors. We shall find, it may be, that many of our industries are carried on according to the old traditions, traditions of practices which were the best known in the days when they were first employed, but which, under the teaching of science in other countries, have been abandoned as obsolete, while they are retained by ourselves. We may find, paradoxical as it appears, that the fact of our having been engaged in any particular manufacture for many years obstructs our readily adopting the most improved forms of carrying on that manufacture, and obstructs it, for I am again about to quote myself, in a way that I pointed out when speaking on the question

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harm by diminishing the nourishing or the curative power of that which was purchased, but fraud which extended to the mingling, in some instances, of materials which were, in themselves, actively unwholesome, materials which, being taken with the food, converted the food into a source of disease, and being taken as curative drugs, converted those drugs into positive poisons.

Is it not too much to be feared that, in some industries, at all events, that reprehensible conduct which has rendered necessary the appointment of public analysts to protect the population of this country, has been the guide of certain of the manufacturers, and has thereby caused us to export that which is a fraud upon the foreign buyer, and a discredit and an injury to the country that exports.

I had intended to refrain from instances, but I will endeavour, in general terms, to state one which relates to a very large industry. It appears that in a certain manufacture the purchasers preferred to buy goods that were dyed in one stage of the process rather than in another, as the goods thus dyed were supposed to be better, and they naturally, therefore, commanded a higher price. The finished goods bore on themselves indications which enabled any purchaser, at all acquainted with the manufacture, to determine at a glance in which of the two ways the article offered to him had been dyed. Then came the deceit. Means were adopted by which the appearance that would have been presented, but for these means, upon the material dyed in the undesirable way, was concealed, so that the appearance really presented was that which would be shown by the manufacture when dyed in the desirable way. It is true that experts in the trade can, after the deceit has been employed, distinguish the one fabric from the other, but the ordinary buyer living abroad, and not suspecting the fraudulent ingenuity that had been exercised in England, and seeing, as he believes, the well-known appearance indicative of the superior mode of dyeing, is deceived, and pays a higher price than he would have paid had he known

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I hardly like to approach this subject at all, because on previous occasions I have, through the kindness of the Society, been allowed to occupy many hours of their time in putting forward my views upon it, and in combatting the views of others, but I am nevertheless tempted to ask you to bear with me while I say a few words upon the question, because I most earnestly and sincerely believe in its importance in relation to manufactures, and because I trust there is to be gathered a hope of a change for the better in public opinion concerning it. From a statement appearing in the *Times* of the 12th inst., there is good reason to hope that the President of the Board of Trade is himself desirous of an improvement in the laws. The paragraph is as follows:—

"MR. CHAMBERLAIN AND THE PATENT LAWS.—A communication on this subject has been addressed by a gentleman in the North of England to the President of the Board of Trade, whose secretary, in his reply, alluding to a recent speech of Mr. Chamberlain's, says:—'I am desired to call your attention to the fact that he (Mr. Chamberlain) was not in a position to promise the amendment of the law, as the possibility of doing this depends upon the condition of public business, and upon the character and extent of the opposition with which the proposals of the Government may be met in the House of Commons. Mr. Chamberlain hopes, however, that time may be found before long for the consideration of the subject, and, as far as his personal opinion goes, it is strongly in favour of removing or lessening the obstacles which now interfere with and discourage invention in this country."

Before any real good can be attained by altering the Patent-laws, it is necessary that those who are charged with the framing of the alteration should consider the question of patents in a totally different light from that in which, in times past, and nearly up to the present time, that question has been considered. Hitherto the framer of a Patent Bill was expected to prepare it on the supposition that on the one side were the public, and on the other the enemy of the public, the inventor, against whom the public, by the ingenuity of the framer of the Bill were to be protected. I submit the true spirit in which the revision of the Patent-laws should be approached is to understand that, on one and the same side, and not in opposition, are the public and the inventor, and that the object of the new law should be to afford that protection to both which would result in benefit to the public and in a fair reward to the inventor.

The popular impression is (I wish I could say "was") that directly an invention connected with an industry is published, all engaged in that industry would use the invention, and thus the manufacture, and through it the population at large, would benefit, were it not that this benefit is delayed for fourteen years because of the patent protection given to the inventor. But the truth is, that so far from manufacturers desiring to adopt an improvement, they would desire nothing better than that their manufacture should have reached the point where improvement is impossible, and where they could sit down and say, "we are up to the very acme of perfection in all our plant and machinery, and in our knowledge of the business. We have no change to apprehend. We can carry our works on as a set trade, and we

price, or on that of quality, or on the score of the higher knowledge possessed, or the better taste displayed abroad. If it be on account of price, let us find out whether the disparity arises principally from the labour question, or whether it arises, as it must do in countries where labour is dearer than in ours, from the use of improved processes in those countries—processes which we have failed to employ.

Again, where we find that the cause of our defeat really does lie in difference of wages, let us see whether it be not possible to improve the application of machinery to such a point as shall render the wages question unimportant compared with other considerations which may be in our favour.

I have sufficient confidence in the skill and ability, and in the amount of capital available in this country, to believe it needs only that the true causes of the success of our competitors should be discovered to make us effectually bestir ourselves to restore the threatened industry to its former safe position.

If we find the superiority of the foreigner to be due to the judicious encouragement and adoption of invention, then I trust that matter will ere long be set right by the promulgation of new Patent-laws, framed on sound principles.

I have hitherto spoken of those industries wherein successful competition has already seriously affected us. But there are others, of course many others, in which we still hold our own, and hold it well. Among these is that of the "carrying trade." No one can read the records which from time to time appear in the papers, of the magnificent steamers which are being built, and year by year are increasing in size and carrying capacity, without feeling a sense of gratification, that on the sea, at all events, England is holding, as she ought to hold, her own. You will have noticed that these steamers have long since ceased to be built of wood, and that iron has been the material employed. You will also have noticed that now gradually, although very gradually, iron is being superseded by steel. It may not be generally known to you, but it is the fact that the United States are now producing enormous quantities of Bessemer steel. The Americans, it need not be said, are hardy mariners, they are daring naval architects, and it only remains for them to have money a little cheaper (and it is becoming cheaper day by day), and to get rid of some of their own restrictive duties, to enable them to apply a portion of this surplus steel to the building of steamers which will enter into competition with our own. Depend upon it, that when such rival steamers are started, every invention tending to economical management and working, and especially, therefore, to the saving of fuel, will be adopted in their ships. And thus it behoves our shipowners and merchants (as well as our manufacturers) to watch all improvements as they are brought forward, to adopt them if sound, and not to wait until the adoption is forced on them, because they find their rivals have already used the improvements, and are thereby enabled to obtain a preference in the ports to which they trade.

I suggested it might be found that a cause of successful competition against us in certain manufactures, arose from a want of knowledge or from a want of taste in those engaged in the same manufacture in our own country. I do not mean the mere rule of thumb knowledge, but the knowledge of the scientific principles involved; and upon this point, although I feel I have trespassed on you at too great a length, I will ask your indulgence for a short time —a very short time. I am one of those who believe that for a manufacture to be carried on successfully under all circumstances of change which may arise, those engaged in it, the principals, managers, foremen, and leading workmen should have a knowledge of the scientific or artistic principles involved in the carrying on of that manufacture. The Society of Arts has long entertained these opinions, and is to be commended for having, in furtherance of them, in the year 1872, established those Technological Examinations, which it adopted in the absence of any machinery for technical teaching to lead persons to educate themselves, so that they might come forward and submit to an examination by competent examiners, and thereby prove their fitness for the position that they occupy.

These examinations were continued until they became a heavy burden upon the resources of the Society, and their utility having been thoroughly established, they were in the condition in which the Society could properly hand them over to any other body competent to undertake them. As most of you are aware, about two years ago, certain of the Livery Companies of London associated themselves together and established the City and Guilds of London Institute for the Advancement of Technical Education. That institute, which was duly incorporated on the 9th of July last, has, amongst its other works, taken over—now for two years—the Technological Examinations of the Society of Arts. In the outset, the institute was aided in the carrying out of this work, by the counsels of your Secretary, Mr. H. Trueman Wood. The result of the two years' working, has been of the most gratifying character. In 1879, there were in all 202 candidates examined in 7 industries, of whom 151 passed in some one of the grades. In this year there were examinations in as many as 24 industries, and in these 816 candidates were examined, and 515 passed in the various grades.

The City and Guilds Institute is carrying on—I wont detain you with the details of what it is doing—technical instruction in many other ways. It has schools of applied art at Kennington, and applied science classes at Finsbury, where it is preparing to erect a building, at a cost of £20,000, to afford more room for its operations. It has contributed towards chairs of fine art, applied mechanism, applied chemistry and metallurgy, in King's College, and in the University College, London. It has helped the Artisans' Institute, it has helped the Society for the Employment of Women, and it has assisted other educational bodies in the country. Moreover, it has obtained a lease of ground for 999 years, at a nominal rent, from her Majesty's Commissioners of 1851, on which there is about to be erected a central institution, from the designs of Mr. Waterhouse, the eminent architect.

During the autumn vacation, I paid a visit to the Polytechnic Institution at Zurich, established in pursuance of a law passed in 1854. I found there a building of about 445 ft. long by

ide, with a central court-yard. I was this building, containing, as it is stated, million cubic feet of availabl? space, had luding two small detached buildings) francs, or practically £100,000 sterling. taught between 900 and 1,000 students, hom I found, by the returns, that there ge proportion of 349 from countries other itzerland, and included in these Great igures for 5 students. This establishment ip at a cost of 455,000 francs, or £18,200 year. Of the revenue, which is slightly of the expenditure, about £3,800 is derived dents' fees, at 100 francs per head per xcept in certain cases, where the instruc- uite gratuitous); £13,800 comes from , £800 from the Canton of Zurich and town of Zurich, and about £120 from ceipts. I felt, I must confess, thoroughly that a comparatively poor country like nd, having a total population, according t census, of considerably less than three should possess an institution of this le, while in England it is difficult to point istence of any such institution at all, and wenty-five years after the example was Switzerland, we are about to establish n, at last, a central institution which, we regard the magnitude of the build- number of scholars, or the number of to be taught, will represent but a fraction e at Zurich. But, nevertheless, a small g is better than no beginning at all. I eat confidence in the result of this on the part of the City and Guilds of Institute. We have hard-working men on ning body, among whom are to be found, to say, the President of the Royal Society, ident of the Institution of Civil Engineers, sident of the Chemical Society, and the n of the Council of the Society of Arts. ily, in the present instance, the City and of London Institute do not possess in this ned official an extra adviser, because it so that your present Chairman of Council is Chairman of the Executive Committee of y and Guilds of London Institute. In hen it was resolved to ask the advice istance of the Chairman of your Council, lfred Churchill was in office, but before the d Guilds Institute was incorporated, and into actual operation, Lord Alfred Churchill o reign, and I came in his stead, so that y and Guilds of London Institute have after ved themselves (as was to be expected) kney sportsmen, for they have shot at a and they have brought down a crow.

I am lapsing into that unseemly levity in indulged in the early part of this evening; that ground, even if not on the ground of ness of the hour at which we have arrived, pedient I should bring my address to a con- , and I cannot more fitly do so than by g you for the attention with which you en good enough to listen to it, and by once romising, in the name of the Council, whose n I have the honour to be, that every effort made throughout the coming session, as been made in times past, to promote the s of the Arts, Manufactures, and Commerce of Great Britain, and thereby to promote the interests and welfare of this Society.

Lord Alfred S. Churchill proposed a vote of thanks to the Chairman for his excellent address, which contained a most luminous statement of the aims and objects of the Society; and he thought the members must congratulate themselves that so distinguished a man held the position of Chairman of Council.

Mr. W. Botly, in seconding the motion, remarked on the interesting programme prepared for the coming Session, and alluded to the long list of candidates proposed for election. He thought they might all help in promoting the objects of the Society by obtaining new members for what he considered one of the most instructive institutions in existence.

Sir Antonio Brady supported the motion, and, as President of the Inventors' Institute, expressed his particular approval of that part of the address relating to the improvement of the Patent-law.

The vote was carried unanimously.

The Chairman then presented the following medals and prizes, awarded during the past session:—

The Society's Silver Medal:—

To Major-General H. Y. D. Scott, C.B., F.R.S., for his paper on "Suggestions for dealing with the Sewage of London."

To A. J. Ellis, F.R.S., for his paper on "The History of Musical Pitch."

To John Sparkes, for his paper on "Recent Advances in the Production of Lambeth Art Pottery."

To Henry B. Wheatley, F.S.A., for his paper on "The History and Art of Bookbinding."

To W. Holman Hunt, for his paper on "The Present System of Obtaining Materials in use by Artist Painters, as compared with that of the Old Masters."

To Thomas Fletcher, for his paper on "Recent Improvements in Gas Furnaces for Domestic and Laboratory Purposes."

To John C. Morton, for his paper on "The Last Forty Years of Agricultural Experience."

To Prof. Heaton, F.C.S., for his paper on "Balmain's Luminous Paint."

To Captain Abney, R.E., F.R.S., for his paper on "Recent Advances in the Science of Photography."

To J. W. Wood, for his Leak Stopper for the Protection of Ships from Sinking.

His Royal Highness the Prince Consort's Prize of Twenty-five Guineas, to William Clarke Hudson, aged 25, of the Liverpool Institute, student, who has obtained the following First Class Certificates at the Society's Examinations, held in the present and three preceding years:—

1877. Book-keeping.
,, Political Economy, with the Third Prize.
,, English, with the First Prize.
1878. Clothing.
,, Health.
,, Cookery.
,, Housekeeping, with the First Prize.
1879. French.
1880. Commercial Geography and History.
,, Arithmetic.

The Council Prize (for Female Candidates) of Ten Guineas:—To Jannet Lucy Mungeam, aged 37, of the Birkbeck Institution, no occupation stated, who has obtained the following First Class Certificates at the Society's Examinations during the specified period:—

1878. Clothing, with the First Prize.
1879. Commercial Geography and History.
,, Cookery, with the second Prize.
1880. Housekeeping and Thrift.

MISCELLANEOUS.

HOUSE-DRAINAGE TESTS.

The Sanitary Section of the Society of Arts have had before them several tests for house-drainage work proposed by specialists. The methods employed by Messrs. Eassie, Rogers Field, and Griffith are set forth in the report of the meeting of the Section, held June 14, 1880. A report from the Board of Health of Boston has since been received, which gives the following account of a mode of testing house-drains, which has been successfully carried out in that city:—

"It is generally known that leaky house-drains are commonly detected by using peppermint, though just how this is done is not so thoroughly understood. Peppermint is not indispensable. Any of the volatile essential oils will answer as well; but, from its cheapness, peppermint is usually employed. It is put up in small vials for the purpose, one vial containing sufficient to test one line of pipe. First, remove all casing there may be around the pipes throughout the building. Stuff tow, rags, or any convenient article, as closely as may be around the pipes where they pass from one storey to another, to prevent the smell from following the pipe upward. If possible station a person on every floor, furnished with chalk or red pencil, to mark the actual location of any detected smell. If the main drain (soil-pipe) extends through the roof, station the operator at that point, with vial and two pails of hot water. Everybody being in position, let the operator pour down the peppermint, and, as soon after as possible, both pails of water, taking care not to spill peppermint on his clothes or on the floor or roof. The observers on every floor should now try to detect any smell they may be able to, and mark any such places with chalk, so that they can be examined in detail at leisure. This is the entire operation. The person on the roof must on no account for at least ten minutes leave his position; for he will surely bring the smell with him to a greater or lesser extent, and leaks may not all be detected in less than that time. If the soil-pipe does not extend to the roof as it should, run the peppermint through the upper water-closet or set bowl. If there be more than one set of pipes, and the first is found leaky, they must be tested on different days, one at a time, as it is impossible to get all the smell out of a house in less time. The cost of the peppermint is two dollars per dozen vials. Length of time required to thoroughly inspect a building, from one to five hours, depending on the complexity of the pipe arrangement."

It is stated that this plan has been adopted for testing the drainage of some of the health resorts in the United States; and, in one instance, it was found that the smell of peppermint was imparted to the water drunk by the guests.

THE SIMLA EXHIBITION.

The Thirteenth Annual Exhibition of the Simla Fine Arts Society was opened by the Viceroy, the Marquis of Ripon, on the 17th of September. For the second time, an exhibition of native and industrial art manufactures was added to the Exhibition of the Fine Arts Society. In his remarks on declaring the Exhibition open, his Excellency said that nothing was easier than to destroy, and of all things art could, perhaps, be most easily destroyed. One form of destruction in Europe was sometimes known under the name of restoration. He hoped the day was not far distant when the ancient monuments of India might be placed under such control as would tend to preserve them intact and unmutilated to future ages. There was, much in the conditions of modern life which tended somewhat to separate and keep apart the European and native in this country, somewhat more than was the case in former days. The rapidity of communication, the weekly mails, the frequent furloughs, in spite of their advantages and blessings, all tend to a certain extent in that direction, and it is, therefore, a great satisfaction to feel that there are other circumstances connected with our time which may counteract the evil, and among them we might count that greater acquaintance we have in the present day with the history, the art, the jurisprudence of the past, which ought to help us to know better, and to appreciate more highly the native civilisation of India, to feel how ignorant is the inclination to disparage it, and that it is upon the ancient foundation of that civilisation alone that we can hope to erect, firm and enduring, the superstructure of that wider and higher life which it should be the great aim of our Government to foster and advance.

THE NATIONAL TRAINING SCHOOL FOR MUSIC.

The third Report of the Society's Committee on the National Cultivation of Music, deals with the charter for the proposed Royal College of Music so far as national cultivation of music is concerned. An article on this subject appeared in the *Times* on November 4th, which treats of the necessity for a better musical organisation in the country, and recounts the difficulties of obtaining it. The *Times* concludes as follows:—

"The practical management of the Royal College will be essentially in the hands of a Council, consisting of the president, the principal and the vice-principal, and 30 ordinary members, a considerable portion of whom, it may be assumed, will be amateurs. In this arrangement, again, a dangerous concession to our inherent hatred of centralisation may be recognised. Without wishing in the least to underrate the services of members of the Royal Family and other distinguished persons whose names will be of the greatest use in a social sense, we may point out that not much serious business can be expected from a large and miscellaneous body of gentlemen, who will meet, perhaps, two or three times in each term, and can scarcely be expected to be acquainted with the working of the institution in detail. The real power must, in the natural course of events, lie with a few professional members, who will, at the same time, be screened from all responsibility by their colleagues. Whether it is safe to place such trust even in the most trustworthy persons is a matter we need not here discuss. Certain it is that if the House of Commons is to be asked for money, it will want the responsibility of a more tangible being than an ornamental Council."

This agrees with the observations of the Musical Committee. The successful working of the Art system, instanced by numerous witnesses as worthy of imitation, is considered to show the nature of the executive management which is required for success.

RIVER FLOODS.

The following letter from Mr. C. N. Cresswell, appeared in the *Times*, of the 16th inst:—

"Permit me, as one of the Executive Committee of the last Public Health Conference at the Society of Arts, held on the 10th of June, to remind you that the subjoined resolution in reference to 'the prevention of floods' was unanimously passed at that Conference by representative men from all parts of the kingdom:—

"'This Conference is further of opinion that such re-

presentative County Boards should be instituted with the least possible delay, and that the functions intrusted to them, and the powers conferred upon them, should be wide and full, and conceived in the view of enlarging, elevating, and re-invigorating the principle of local self-government in this country; and, further, it is the opinion of this Conference that such County Boards, or combinations of them, in preference to newly-constituted authorities, should be charged with the conservancy of rivers, including the prevention of floods, the storage of water, and the preservation of rivers from pollution; and, lastly, that such County Boards should also be charged with the appointment of county health superintendents in each county.'

"This resolution, if carried into effect by Parliament, offers a solution of the formidable difficulties submitted to the consideration of Mr. Dodson on Thursday last, by the Duke of Bedford and others. Moreover, it seems to be forgotten that floods no longer leave a rich deposit of clay and other detritus upon our pastures, but, in too many cases, a filthy slime, infected with the poisonous refuse of towns and manufactories along the course of our rivers. In the opinion of some practical farmers, this is one of the causes of the abnormal diseases now prevailing among our flocks and herds, more especially among store cattle. In this aspect the question becomes one of tremendous importance, as affecting the agricultural interests, and deserves the immediate attention of Parliament."

CORRESPONDENCE.

PATENT LAW.

I have the pleasure to forward herewith a copy I have received for the Society of Arts, of the volume recording the proceedings of the "Congrès de la Propriété Industrielle," held at Paris in September, 1878, and which was attended by delegates from the Governments of Germany, Spain, the United States of America, Hungary, Italy, Luxembourg, Norway, Russia, Sweden, and Switzerland.

It may be convenient that I should take this opportunity of making a few observations as to resolutions arrived at by the Congress, some of which agree more or less with certain of the resolutions I had the honour of submitting, at the request of the Council of the Society.

The subjects enumerated in the programme included patents for inventions, industrial designs, trade marks, &c. The action taken in relation to each subject is so fully recorded in the accompanying volume, that it will no doubt be deemed sufficient if I confine my remarks to the particular branch to which the Society's resolutions had reference, viz., patents for inventions.

It will be recollected that Bills for the consolidation with amendments of the Patent-laws of the United Kingdom were introduced in the House of Lords by the late Lord Chancellor in 1875 and 1876, and in the House of Commons by the late Attorney-General in 1877.

Special meetings to consider the Bill of 1877 were held by the Society of Arts on the 6th and 9th of March in that year, when certain resolutions were passed, which will be found in the Society's *Journal* of March 16th, 1877. These were the resolutions the Council of the Society submitted to the Paris Congress. One of them (the second) had reference to the preliminary examinations of applications for letters patent, and was as follows, viz., "That no adverse report of an examiner, even with a right of appeal, ought to preclude an applicant from obtaining a patent at his own cost and risk. And further, that reports containing opinions of Patent-office authorities ought not to be made public, but that opportunity should be given to the applicant of amending his specification, by inserting reference to matters discovered by the authorities, with a definite statement of what he nevertheless claims."

The subject of preliminary examination gave rise to a long and animated discussion, and was dealt with from various points of view. The advocates of such an examination pointed out the large number of supposed inventions for which patents were taken out, and which, while only delusive, and injurious to the patentees, were, they urged, often incumbrances in the path of subsequent inventors. They argued that a previous examination by capable experts would frequently prevent these patents from being granted at all. Accordingly, our own Parliamentary Committee of 1872, the Vienna Congress in 1873, and the German Reichstag in its law of 1877, had all decided in favour of an examination. On the other hand, it was forcibly urged that the power of rejecting untried inventions for supposed want of novelty, impracticability, triviality, or any similar reason, would be a most dangerous weapon to put into the hands of examiners, however honest and capable; and instances were cited of inventions which were condemned by the highest authorities, on one or other of these grounds, and which yet proved to be most valuable. The French Patent-law, like our own, does not provide for any such examination, and it seemed possible that there would be a majority of French members against a minority containing most of the foreign delegates. However, an almost unanimous vote was at last taken in favour of a proposal based on the Society of Arts' resolution already referred to, and designed to meet both sets of advocates. The resolution, as passed, may be freely translated thus:—"Patents of invention should be granted to any applicant at his own risk; nevertheless, it is desirable that the applicant should receive a previous secret opinion, notably on the question of novelty, so that he may, at his option, maintain, modify, or abandon his claim."

As bearing upon compulsory licenses, the following free translation of a resolution of the Congress may be given:—"A patent should, during the whole of its term, assure to the inventor or his representatives the exclusive right to work the invention, and not a mere right to a royalty to be paid him by third parties working the invention."

As respects compulsory working, the Congress adopted a resolution to the effect that "it is desirable to admit of forfeiture for default of working within a term to be determined, unless the patentee justify the causes of his inaction." I may perhaps say, speaking from experience, that this resolution strikes me as most objectionable.

The Congress expressed the opinion that "a special office of industrial property should be established in each country. A central depôt of patents of invention, trade marks, and industrial designs should be annexed for the purpose of communication to the public. Independently of any other publications, the office of industrial property should cause an official sheet to be issued periodically."

As respects fees, the resolutions of the Congress may be stated thus, viz. (1) that the tax on patents should be periodical and annual; (2) that it should be progressive, commencing with a moderate initial sum; (3) that it should only be demandable in the course of the year; (4) that forfeiture by reason of default in the payment of the tax should not be pronounced, except after the expiration of a certain delay after it becomes due; (5) that even after the expiration of this delay, it should be open to the patentee to justify the reasons of his having been prevented from paying; and (6) that this forfeiture should be pronounced by the ordinary tribunals, and not by the administration.

One of the most important resolutions passed was to the effect "that the rights acquired by patents or the registration of designs and trade marks in different countries, should be independent of each other, and in no respect interdependent, as is now the case in many countries."

It would be almost impossible to exaggerate the importance of this point, especially seeing that the country heretofore regarded as possessing the most liberal Patent-law, viz., the United States of America, seems now to be straining the interdependent theory to the very utmost extent, thereby seriously hampering patentees, without, so far as I can see, any adequate gain to the public. I think it will be found the resolutions above enumerated are those which deal most nearly with the points analagous to those to which the Society of Arts' resolutions already mentioned had reference.

Before separating, the Congress appointed a permanent committee to continue the work it commenced. This committee is composed of sections, one for each of the countries represented, the French section being the executive committee. The English section consists of Admiral Selwyn (chairman), Sir W. Thomson, F.R.S., Sir Henry Bessemer, F.R.S., Mr. Gorst, Q.C., M.P., Mr. J. G. Alexander, LL.B. (hon sec.), and myself. Unfortunately, the committee recently lost a very active member in Mr. Olrick, C.E., who died in August last.

Since the Congress, the permanent committee have occupied themselves in forwarding the carrying out by the Governments of Europe of the resolutions of the Congress, and with this object the French section of the committee entered into communication with their own Government. The French Government having expressed its willingness to take the initiative in bringing about some measure of international concert, the French section prepared, and laid before it, a proposal containing those resolutions of the Congress which seemed capable of immediate realisation for an international convention for the protection of patents, trade marks, and designs; and this proposal was sent round to the different Governments by that of France, together with an invitation to concur in an international conference for the purpose of settling such a convention. Several Governments have expressed their willingness to take part in such a conference, and I understand it will shortly be held.

At the same time, the French section of the committee, desiring to complete the work of the Congress with regard to those questions which it had been unable to enter into, prepared and sent round to the different national sections *questionnaires* to elicit their opinions on these points. Two such *questionnaires*, one on patents, and the other on designs, have been sent round, and answers have been supplied by, at any rate, the greater part of the sections. W. Lloyd Wise.

7, Whitehall-place, London, S.W.,
October 30th, 1880.

GENERAL NOTES.

Fleuss's Diving Apparatus.—Messrs. Fleuss and Duff have called attention, in a letter to the editor of the *Times*, to the successful use of Fleuss's Patent Diving Apparatus, in that part of the Severn tunnel which is now inundated: — "The diver has succeeded in getting down the shaft, some 200 ft. deep, and then going a quarter of a mile up to the head of the tunnel, in order to close up the door so that the pumps might be enabled to clear the water out. After several unsuccessful attempts with the ordinary gear, we were applied to for our apparatus, and this was tried on Thursday, and proved a complete success, the diver easily accomplishing what had become an impossibility with the ordinary means of diving, owing to the great length of air tube necessarily required."

The Electric Light.—Satisfactory progress is being made in London and Paris with the Jamin system of electric lighting. Mr. Bell, the representative of the company here, is employed in fitting up an extensive plant at the establishment of Messrs. Samuel Brothers, to replace the Jablochkoff lights in use there last year. The machines will be driven by a 12-horse power silent Otto gas engine, which will actuate two self-exciting Gramme machines working from four to sixteen Jamin lights each, and which will be employed to feed twenty lamps, unless the power available should be sufficient for the whole thirty-two lamps. The speed of the Gramme machines will be 1,600 revolutions per minute. During some recent experiments in Paris, a pair of Gramme machines, exciter and distributor separate, and of the type formerly known as four-light machines, were able to maintain, when driven at a speed of 2,500 revolutions per minute, sixteen Jamin lights. The machines had been slightly altered by M. Jamin, and can be driven at 3,000 revolutions per minute without appreciably heating the coil. The Royal Panorama building now being completed in Leicester-square is to be lighted with thirty Jamin lights.—*Engineering*.

MEETINGS FOR THE ENSUING WEEK.

Monday, Nov. 22nd...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Prof. A. H. Church, "Some Points of Contact between the Scientific and Artistic Aspects of Pottery and Porcelain." (Lecture I.)

Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. Francis Turner, "The Law as affecting Quantity-Surveyors."

Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. Right Hon. Sir H. Bartle E. Frere, "Temperate South Africa considered as a Route to the Central Equatorial Region."

Medical, 11, Chandos-street, W., 8½ p.m.

Tuesday, Nov. 23rd...Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. 1. Mr. J. P. Maxwell, "New Zealand Government Railways." 2. Mr. J. R. Mosse, "Ceylon Government Railways."

Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m.

Royal Colonial, the Grosvenor Gallery Library, 135, New Bond-street, W., 8 p.m. Mr. T. B. H. Berkeley, "The Leeward Islands."

Wednesday, Nov. 24th...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. J. Comyns Carr, "The Influence of Barry upon English Art."

Telegraph Engineers, 25, Great George-street, S.W., 8 p.m. Mr. J. W. Swan, "A System of Subdividing the Electric Light."

Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m. Mr. F. G. Fleay, "The Living Key to English Spelling Reform now found in History and Etymology."

Thursday, Nov. 25th...Royal, Burlington-house, W., 8½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
Philosophical Club, Willis's-rooms, St. James's, S.W., 6½ p.m.

Friday, Nov. 26th...Quekett Microscopical Club, University College, W.C., 8 p.m.

Clinical, 53, Berners-street, W., 8½ p.m.

Saturday, Nov. 27th...Physical, Science Schools, South Kensington, S.W., 3 p.m. 1. Dr. J. H. Gladstone, "Refraction Equivalent." 2. Lieut. L. Darwin, "The Rate of Loss of Light from Phosphorescent Surfaces." 3. Mr. D. H. Coffin, "Minor Applications of Electro-Motors."

Royal Botanic, Inner-circle, Regent's-park, N.W., 3¾ p.m.

PRACTICAL EXAMINATIONS IN VOCAL AND INSTRUMENTAL MUSIC.

The next examination at the Society's house will be held during the week commencing January 10th, 1881. Particulars will be forwarded on application to the Secretary, Society of Arts, John-street, Adelphi. No names can be received after the 24th December, 1880.

NAL OF THE SOCIETY OF ARTS.

No. 1,462. VOL. XXIX.

RIDAY, NOVEMBER 26, 1880.

mications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

THE PHOTOPHONE.

the announcement in the last number of rnal, Professor Graham Bell, who happens or a short time, in England, has agreed to paper on his "Photophone" before the , on Wednesday, 1st December, in place of H. Preece, who is unable to read his paper day. Mr. F. J. Bramwell, F.R.S., Chair- f the Council, will preside. For the con- e of those members who wish to be present, ual rules for the admission of members eir friends will be suspended. Admission will ticket only, and no person, whether a mem- not, can be admitted without a ticket. A nt number of tickets to fill the room will be to applicants, in the order in which they Each ticket will admit one person, and is rable. Not more than a single ticket can ed to any one member. Some tickets have y been issued, but it is hoped that all rs who apply in good time may be accom- d; they should, however, apply at once to retary. By order,

H. TRUEMAN WOOD, *Secretary.*

UNION OF INSTITUTIONS.

following Institution has been received into ion since the last announcement :—

ester-house School Science and Art Classes, ton, near Sittingbourne.

FOREIGN AND COLONIAL SECTION.

eeting of Committee of this Section was n Thursday, 19th inst., at 4 p.m. Present: Rutherford Alcock, K.C.B. (in the chair), ndrew Cassels, Mr. Hyde Clarke, Mr. C. des, Mr. Trelawney Saunders, Mr. J. A. Youl, Mr. H. Trueman Wood, secretary, and Dr. Mann, secretary of the Section. The pro- e of papers to be read during the present was discussed and agreed upon.

CANTOR LECTURES.

first lecture of the first course was delivered nday, 22nd inst., by Prof. A. H. Church, F.R.S., on "Some Points of Contact between the Scientific and Artistic Aspects of Pottery and Porcelain." The lecturer dealt with bricks, tiles, terra-cotta, basaltes, and unglazed earthenware in general. The lectures will be printed in the *Journal* during the Christmas recess.

BARRY'S "VICTORS OF OLYMPIA."

With the present number of the *Journal* is issued, as a supplement, an engraving of Barry's picture of the "Victors of Olympia." The engraving is intended to illustrate Mr. Comyns Carr's paper on Barry, and is reproduced from the woodcut published by the Art Union in a series of "Thirty Pictures by Deceased British Artists, engraved by W. J. Linton." The block has been kindly lent for this purpose by the Council of the Art Union. A small number have been printed on better paper, and any member who wishes for a copy to bind with the *Journal* can have one, gratis, on application, or a copy will be posted on receipt of one shilling.

PRACTICAL EXAMINATIONS IN VOCAL AND INSTRUMENTAL MUSIC.

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PROCEEDINGS OF THE SOCIETY.

SECOND ORDINARY MEETING.

Wednesday, November 24th, 1880; Sir HENRY COLE, K.C.B., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Brenchley, Samuel, Hunt Bridge-house, Matlock.
Gassiot, Charles, Elmwood-house, Upper Tooting.
Gundry, Joseph Pearkes, the Cottage, Bridport, Dorsetshire.
Jaques, Leonard, J.P., Wentbridge-house, Pontefract, Yorkshire.
Laxton, Frederick, Brighouse, Yorkshire.
Nix, John H., 77, Lombard-street, E.C.
Noel, Hon. Henry, 17, Westbourne-terrace, W.
Northampton, Marquis of, Castle Ashby, Northampton.
Ormerod, Thomas, Woodfield, Brighouse, Yorkshire.
Robertson. Sir D. Brooke, C.B., Athenæum Club, S.W.
Robertson, J. Murray, Lower Grove-house, Roehampton.
Seymour, Major-General W. H., Travellers' Club, Pall-mall, S.W.
Sheppard, Samuel Gurney, 31, Oxford-square, W.
Simmons, Charles J., 56, Leverton-street, Leighton-road, N.W.
Skaife, John Slade, 32, Milner-square, N.
Slade, Francis William, Eldon-pk., South Norwood, S.E.
Volk, Magnus, 40, Preston-road, Brighton.

The paper read was—

THE INFLUENCE OF BARRY UPON ENGLISH ART.

By J. Comyns Carr.

In the summer of the year 1788, a young Irish artist arrived in London, bearing a letter of introduction to James Barry. At that time Barry had accomplished the great work of his life. The pictures which hang round the walls of this room, and which are justly reckoned as the highest effort of his genius, had been completed in 1783. In the previous year he had been appointed professor of painting in the Royal Academy, and his exercise of the functions of this office had not yet led to the series of unhappy and unfortunate disputes which terminated at last in his expulsion. Barry may, therefore, be said to have been in the full enjoyment of his fame. The youth who came to seek his friendship was, on the contrary, only just entering upon his career. Martin Archer Shee was destined to rise to the highest dignity in his profession. Forty years later he became president of the Royal Academy; and the courtly manner in which he discharged the duties of his position tend, perhaps, as much as his purely artistic gifts, to the permanence of his fame. We may assume that he already possessed some of those essential qualifications for success which Barry had always lacked. Indeed, his biographer assures us that even at this early age the young man's manners were regulated by "the highest standard of social propriety which the circles of Dublin afforded," and that such was his punctilious exactness in matters pertaining to the toilette, that, in common with most of the men of fashion of his time, he passed an hour every day under the care of his hairdresser. It is impossible to conceive of a more striking contrast than is presented between this elegant youth and the morose and solitary artist; and it is easy to imagine the shock which such a polished young gentleman must have experienced on his first introduction to Barry in his poor and lonely lodging. Writing home to his brother immediately after his visit, Shee preserves for us this lively picture of the artist and his surroundings. "Conceive," he says, "a little ordinary man, not in the most graceful dishabille, a dirty shirt without any cravat, his neck open, and a tolerable length of beard, his stockings, not of the purest white in the world, hanging about his heels, sitting at a small table in the midst of this artificial confusion, etching a plate from one of his own designs." And of the apartment itself he continues in the same strain. "The floor," he tells us, "seemed never to have experienced the luxury of an application of soap and water. The centre of it was covered by a carpet, the colour of which might once have been discoverable, but, from its intimate connection with dust and dirty feet, had long since ceased to be distinguishable from the more exposed part of the flooring." "The walls," he adds, "were perfectly concealed by an innumerable quantity of little statues, busts, and old pictures, besides casts of legs, arms, skulls, bones, hands, feet, sketches, prints, drawings, palettes, pencils, colours, canvases, frames, and every other implement calculated for the use of art, disposed in all the confusion and disorder of the most negligent carelessness."

There is something eminently suggestive in the meeting of these two men: the one young and confident, gifted with the social qualities that ensured the sympathy of the world, and attached to a branch of art which at that time offered the only safe road to wealth and fame; the other, not yet old in years, it is true, but already arrived at the limit of his hope and ambition, cursed with a nature that had left him almost without friends and wholly without patrons, disappointed in the pursuit of a kind of art that was strange to the temper of his time, yet still resolute in the labour he had undertaken, and steadfast to the last in the faith with which he had entered upon his career. Twenty years had passed since Barry himself had come, like Shee, to try his fortunes in London, and now, although he had still many years to live, his career was practically ended. In spite of the bright hopes of the lad himself, and of the friends who had recognised and encouraged his earlier efforts, that career had been a failure. I have said he was just then in the full enjoyment of his fame, but, in truth, he never really won the sympathy of his generation, and his fame brought with it but small earthly reward. In this very year he was pleading with the Duke of Richmond for a place in the Ordnance Department, in order that he might find ease and time to produce something worthy of the eighteenth century. He was straitened in circumstances, and embittered by the sense of his isolation, and the imperfect recognition of his fellows. But this was not all. If Barry had only missed the appreciation of his time, it would be indeed a pleasant task for us of a later day to review the hardships of his life, to mark the noble aim which he ever kept before him, to recall his extraordinary resolution and self-denial, and to welcome as our inheritance the great results he achieved. Unhappily, however, Barry's failure was within as well as without. The embittered circumstances of his life have for us an extra note of pain, for the reason that we cannot rate at the value he set upon them the works that he spent his strength in producing. We cannot but perceive, looking back after this lapse of time, that between the grandeur of his conceptions, and the shapes in which they were expressed, there is a gap such as he did not dream of. I do not mean to deny the admirable qualities of Barry's work, I am well aware of the difficulties under which he laboured, and I am anxious to recognise, at its full value, the extraordinary courage with which he imagined and carried to completion the most extended experiment in decorative design which has yet been produced in this country. That, without any national tradition to guide him, and without the encouragement of contemporary examples, he should have executed the vast canvases that surround us to-night, proves, I think, that Barry possessed real power as well as a noble ambition. And yet, when all has been said that justice demands, there must still remain, I think, a painful conviction of Barry's failure. We may admit that he was not rightly understood by his age, but we must also acknowledge that he did not truly understand the kind of beauty in art which he desired to express. Of the dead, we are told, we should say nothing which is not good. It is a poor saying, for the dead of all men most sternly reject insincerity of praise, and it is no injustice to Barry's memory, to distinguish truly the inherent limitation of his powers. Rather it may be said, that the sense of

hool, we shall see that, although his want ss was partly due to the temper of the d the quality of his genius, yet that it a deeper and truer sense, to be ascribed to per of his time, and to the general con- under which painting had been practised pe. Other men might have won greater and a larger share of popular homage. 1, whatever his disposition, could have at that time, for absolute success in the f art which Barry sought to inhabit; and fore becomes a question of peculiar interest der what there was in the spirit of the age, he general condition of the art, to shut out abers of our English school from the highest is of imaginative design.

he causes of that strange isolation in which ed his life, we must indeed look to the facts character. Barry, even in his boyhood, an inclination to separate himself from his . Born at Cork, in the year 1741, he was destined for his father's business of a g trader; but he quickly discovered a talent ign, and while he was still at school, he l upon an independent course of study, and nixed in the ordinary boyish games or amuse- While others were at play, he would steal is room and set to work with his pencil, or imself in the reading of some book that he rrowed or bought. He used to alarm his by sitting up all night at his work, and they strove to force him to rest, he would is door, and allow no one to enter his not even for the purpose of making bed. When he was scarcely twenty, gan a picture of St. Patrick landing coast of Cashel, and with this first trial of ength he journeyed to Dublin, where he just in time to have the work displayed in hibition of the Society. Here it attracted ice of Mr. Burke, and thus there began, n the statesman and the painter, a friend- at endured for many years, and the records

and your credit as much as any man." To pre- serve during all the years of their intercourse this kindliness of feeling, must often have been to Burke a matter of difficulty and trial. Not that Barry was at any time indifferent to the value of the friendship that subsisted between them, or disposed to underrate the great benefits which it had conferred upon him. But he could not, at all times, govern his temper; he was apt to let slight and trivial disagreements obscure the memory of a noble friendship, so that there came at last a time when Burke, instead of beginning his letters with the familiar words, "My dear Barry," came at last to adopt the chilling form of "presenting his compliments" to the solitary artist. But in these earlier days Burke shows no sign of sensitiveness in his own person; all his anxiety is for Barry's future, and for the evil that he will bring upon himself, unless he can learn to bear with his fellow-men, and to keep his mind in tranquility for his work. Barry had already made himself unpopular with the artists in Rome, by seeking, with too much candour, to expose the tricks and frauds of the dealers in antiquity that haunted the city. Reynolds, who took a genuine interest in the young Irishman's career, is called in to give advice. Burke adds some of his own to the same effect. The wrathful and irascible student is warned by both against being led away from his own concerns by the malice and envy of others. He is advised to let these pretty tricksters go their own way in- stead of quarrelling with them. "There is," says Burke, "no living in the world upon any other terms." These small incidents in Barry's sojourn at Rome would be scarcely worth quoting, save for the indication they afford us of the morbid element in his character. In a letter written during the latter part of his stay abroad, we get the first hint of that deep strain of melancholy and mistrust, which was so strangely combined with his arrogance and irritability. Speaking of his approach- ing return, he writes in a desponding fashion of the

enthusiasm. His whole life proved that Barry was ready and willing to make any sacrifice for his art; and there is in all the history of art no more notable instance of absolute devotion to an ideal, a devotion which, in regard to material concerns, made no claim upon the indulgence or forbearance of others. Those who came in contact with Barry, had assuredly much to bear from his perverse and ungovernable disposition; but it is at least a noble trait in his character, that he duly counted the cost of each adventure he was to make, that he did not seek to shift his burdens on to other shoulders, and that the full extent of his failure fell chiefly in hardships inflicted upon himself. At the time that he undertook the decoration of this great room he had, so his biographer tells us, but sixteen shillings in his pocket; and during the execution of these vast canvases, he was constantly compelled, after his day's work was done, to employ himself in the evenings on drawings and etchings for the publishers. Barry's arrangement with the Society, as you are doubtless aware, through the interesting account of these transactions lately issued by your Secretary, was that he should paint these pictures at his own risk, the Society only undertaking to provide the materials, and to hand over to him the receipts arising from their public exhibition. Barry never flinched from the labour; but he must, at times, have looked forward with something like dismay to his means of livelihood during the progress of the work. In such a mood it must have been that he penned a letter to Sir George Saville, one of the vice-presidents of the Society, asking that gentleman to head a subscription in order to give the painter command of a hundred pounds a year. There is no record of any practical issue to his appeal, but to me, I confess, there is a simple dignity in this letter, which aptly accords with the proved integrity of the man. "My request and wish," he says, "is that you, sir, would subscribe £20 or £10 yourself, and prevail with such of the Society as you think proper to subscribe also, to make in the whole the annual sum of £100, to be given me monthly or quarterly, as the work goes on. I shall, by that means, be enabled to give myself up entirely to it until it be finished, which, with God's blessing, will be in about two years; and then the sum of £200, which I shall have received, shall be paid back to you and to those other public-spirited gentleman who lent it to me. If the exhibition produces nothing, or that the Society should neglect to make one, you will then lose your money; but a public work will be completed, and I shall be happy; as the opportunity of throwing myself out in such a work will be, to me, a reward fully sufficient."

This frank appeal seems to me wholly worthy of the man, and of the generous spirit in which he had undertaken this great work for the Society. That he was partly impelled by personal ambition is, no doubt, true enough. What artist is there who does not feel and acknowledge the desire of fame? But he was quite as powerfully urged to the undertaking by a truly noble desire to establish in the English school a tradition of monumental design. He had been disgusted and enraged by the failure in the previous year of the scheme for the decoration of St. Paul's; and when Reynolds and the other members of the Academy declined the invitation of the Society to decorate this room, he came forward with alacrity and took the labour altogether upon himself. It would be easy to multiply instances bearing witness to the finer side of Barry's character; but, alas! it was not always easy for those who were his contemporaries to do justice to the grandeur of his ideas. His most generous schemes, devised for the advancement of English art, were so complicated by the violence of his temper, and by an ungenerous mistrust and suspicion of his fellows, that we are not to be surprised if he sometimes, during his career, received less than his due share of praise. His quarrel with the Academy brings prominently before us both the best and worst sides of the man's nature. The employment of the professorial chair for personal attacks upon his brother Academicians must have been intolerable to them, and I can understand that they should justly decide to deprive him of his office; but I do not understand, nor do I think any just mind can now defend, the course which they took in expelling him from the society. I cannot forget, for my own part, that Barry was not merely an intemperate lecturer, but that he was, at the same time, an enlightened and persistent advocate of reform. He incurred the displeasure of the Royal Academy, not only for his personal arrogance, but because he urged upon that body such a large and liberal conception of their duty towards the public, as did then, and has ever since, met with stubborn and dogged resistance from the majority of its members. The present is not the fit time to enter upon a question of this magnitude, but so much, at least, may be said, that if the Royal Academy had followed the lines of policy which Barry laid down, it would now be occupying a very different and a more dignified place in the esteem of the nation, and of the general body of artists. We cannot conceive of such an institution as Barry contemplated ever claiming, as the Academy once claimed, to be a private society independent of national control.

When we turn from Barry's character to Barry's art, we get upon less disputable ground. I shall not attempt to-night, with any fullness of detail, either to expound the merits or to mark the defects of Barry's painting. His most important work hangs before your eyes, and I scarcely think it likely that there is in our time room for much dispute as to the intrinsic value of the result. Whatever praise may now be accorded to his talent, would go but a little way towards satisfying the claims that were at one time put forward on his behalf. His indulgent biographer contrasts his genius with that of Raphael, not altogether to Raphael's advantage; and Barry himself, I think, believed that he had established a style combining the noblest qualities of the antique with the chosen excellence of the greatest of the Italians. Looking back with that cruel clearness of vision which comes with lapse of time, we can perceive the absolute insecurity of these pretensions. We are able to recognise that such art as this, could not, in its nature, be a full or satisfying expression of the mind of its epoch. The failure, as we have already observed, was in this sense not Barry's alone; as he was among the first, so also he was in the same respect the

ress the movement, the passion, and iety of human life. Men who swore e to such a straitened ideal were com- even against their will, to falter in votion to nature, and to rigidly exclude eir sympathies the feelings and sentiments age. Even a genius so true and so refined man's could not wholly escape from the this fashion. He was so far restrained by ailing spirit, that he could only reconstruct sic ideal within the limits of a domestic e. So often as he ventured into a wide o often do his works bear the impress of ; learning rather than of individual power. d not express, through classic forms, the e of the modern spirit; he had not the a which could forge the link to bind the ı the new, and if we compare his transcript k art with that which had been made by sters of the Renaissance, we shall have to that, although it bears externally the marks eater fidelity to the past, it has not an equal hy to attach itself to the realities of a world.

: can recognise this limitation in the noblest re of the time, how much more strongly impress itself upon the products of an art resources imperatively demand vividness of ion, and whose effects are therefore forced oser comparison with the facts of nature. ıg, of all the many forms of artistic expres- an the least afford to accept a convention seeks to exclude from its views the energy ssion of actual life; and, in yielding to such nence, it must inevitably take refuge in the ss grandeur of Barry's colossal style, or to the pretty insipidities of a Cipriani or a ıan. But this devotion to a false and l idea of antique grace was not merely a of weakness in itself; it served no less to e the painters of the eighteenth century of l benefit they might have derived from the ıg and example of the great masters of the

cess of investigation could not be expected to reach the real spirit of Italian art. It was conducted by men who were intellectually already pledged to an impoverished ideal, which a pedantic criticism had chosen to graft upon antiquity, and who, therefore, discovered that Raphael and Michael Angelo had little to teach, which could not be better acquired from the surviving records of the art of Greece and Rome. There was, indeed, one man in England, who possessed a keener insight into the great imaginative design of Florence, and better understood the uses of its example. The genius of Blake shot a momentary radiance across the dull sky, which others could not penetrate at all, and then sank downward, with no sure footing to tread the earth. He had the vision which showed him how great a thing painting had been when it stood as the mirror of men's highest imaginings, and he was quick to perceive the extent of the change that was needed before English painting could hope to undertake this difficult duty. But he must be judged as a seer rather than as an artist, for he had no strength sufficient to effect the revolution he so ardently desired, and while he failed through lack of practical power, others who were, like Barry, more perfectly equipped, failed no less from the lack of that intensity of imagination which in Blake was developed to the point of disease.

The defects that might be anticipated from this superstitious devotion to classic style, with its consequent misapprehension of the greatness of Italian design, are easily traceable in the works of Barry. We are struck at once, in looking at his pictures, with the want of individuality, not merely in the features but in the forms, with the lack of passion and character in the faces, with the absence of expressive energy in the movement of the limbs. The action is either tame or exaggerated; the figures, even where the scale is colossal, are wanting in grandeur and dignity, and, at first sight, these things are more surprising, seeing that there existed at this time another kind of art which

Barry attempted, he too would have failed in a greater or less degree, and it remains for us to consider, as one of the most interesting problems connected with art history, in what manner the gradual progress of painting in England and in Europe had led to the decay of imaginative design, and to the assured supremacy of the departments of portrait, landscape, and the realistic illustration of contemporary manners. Looking first to England, we may see that the force of the Reformation, whatever may have been the gains in a spiritual sense, had unquestionably the effect of suddenly snapping the artistic tradition. It is not to be said that, even under more fortunate conditions, our early English painters could ever, by their independent effort, have enlarged the capabilities of their art as to render it fit to compete with that of other nations, but it is nevertheless true that, up to the time of the Reformation, English painting had a real existence; and if we go back to a still earlier date, we shall discover a period when the illuminated works of English MSS. were the most perfect in Europe. If, then, the Reformation, with the Puritan movement by which it was followed, had not entirely depressed the artistic spirit, the successive revolutions of style, which were deferred till the next century, might have more rapidly completed themselves, and the English school, as we now know it, would have had an earlier birth. But, when the Reformation came, the imaginative impulse was turned into a different channel. The force of the Protestant feeling expended itself in denunciation of the ornate luxury by which the earlier ritual had been surrounded, and, in the condemnation of Romish doctrine and practice, it was inevitable that all the outward graces of life, and the arts by which they were sustained, should be temporarily discouraged. Imagination, escaping from the control of the Church, and seeking for itself a freer realm, became, by a strange irony of fate, one of the strongest elements of opposition to the art which, of all others, most imperatively needs imagination; and the artist, thus deprived of the sympathies of those who led the new movement of ideas, made scarce any effort to keep pace with the intellectual development of the time. All the strength of our Renaissance found expression in our literature, and we are left to guess who, among the earlier poets of our school, might, under different conditions of national life, have become great imaginative painters. I know not if it is only a fancy, but I have sometimes thought that in the author of the "Fairy Queen" there dwelt the soul of a painter; and in the precise and ordered pattern of his verse, so richly and so lovingly adorned with the description of all that might give delight to the eye, we have enshrined a series of visions that might, under other conditions, have found their way on to fresco or canvas. But it is only in the earlier stages of our literature that we are permitted to indulge such fancies, for soon the poet became also the dramatist; and the drama, while it is the highest expression of the literary spirit, serves also most clearly to assert the distinctions between the modes of literature and art.

Seeing, then, how completely literature had absorbed the national energies, it is not surprising to find that the after growth of art in England is due to a foreign source. In the minds and in the homes of the cultivated classes, the taste for art survived, and we had great collectors and connoisseurs before we could boast of great artists. Even before the Reformation had left its mark upon the English spirit, Holbein had found a home at the English Court, and when the work of the Reformation was complete, or nearly complete, Rubens, and his great pupil, Vandyck, were invited to our shores. At first sight, indeed, it may seem strange that the residence among us of these great masters of the craft did not avail, at once, to establish the tradition of imaginative design, but the solution of this riddle is to be sought as well in the nature of the art of which these men were the professors, as in that determined impulse towards literature of which we have already taken account.

When Vandyck entered upon his career, painting, it must be remembered, was no longer fit to undertake the expression of the higher problems of the spirit. In the hands of Rubens himself, art had already reached and surpassed the utmost limits of artistic license. The force, no less than the failure, of his invention put an end for a while to all further study of imaginative design, and the fallacious splendour of his most ambitious achievement was more than enough to drive other artists of less gift, or of greater refinement, into a narrower realm. To realise the decadence in the spiritual elements of painting that had been effected by the time Rubens's career was complete, it is only necessary to refer to his own copy of Mautegna, in the National Gallery, and to compare it with the original cartoon at Hampton Court. As we stand before the brilliant essay of this matchless master of the brush, we have to confess to ourselves that one great epoch in ideal art was closed when gods and goddesses descended to take upon themselves the ample flesh of Flemish men and women. Rubens himself was passionately attracted by the noble inventions of the great masters of Italy, and, with his unapproachable talent, he, if any man, could have revived and sustained the tradition they had established. He had lovingly copied their paintings, and studied their drawings; he had passed from Venice to Florence, reaping, as he went, all the harvest that was still left upon the field; and yet, as often as he tries to emulate these earlier triumphs, so often does he assert, with all the frankness of his genius that their empire had ended, and that art had entered upon a new career.

It is no part of our task to-night to follow th growth, or to note the decay, of the imaginativ schools of Italy; and we have no right to linge over those noble aims in painting which Giotto ha furnished, and to the fulfilment of which th mighty genius of Michael Angelo was finally sum moned. All that we have to observe is, tha painting in the hands of such a race of gifte artists as the world never before had seen, and perhaps, never shall see again, was at last so raise in dignity and power, that the world itself an all the fortunes of humanity became reflected i the shapes of its creation. Starting with th duty of illustrating the legends of the Christia faith, these men of Florence had so deep penetrated the secrets of nature as to be led last to recognise, with the delight of new di covery, the charm and power of the antique; a

vancing with the models of the antique them, and with the strength of their own to save them from the pedantries of mere ı, they were able to create a style for es, large enough to express all the aspira- ıe fears, and the fate of humanity, and, nough to keep its hold to the end upon the nd simplicity of nature. But, with the Michael Angelo, the bright day of Floren- passed swiftly away into darkness, and we look elsewhere for the growth of those that still kept their vitality when they nsported into the practice of the schools ıern Europe.

, for a while, and in her earlier days, ued, with Florence, the study of spiritual ıd, so long as the name of Mantegna re- ıs a power at Venice, the products of the pt about them something of their primitive We may recognise the influence of ıa's genius while Titian was still in his ıd early manhood, but Titian, with a career ended to the verge of a century, lived to and partly to effect, the first changes in a on that was destined to colour the art-work ceeding generations. Of a genius too great ere to labour in the service of an expiring ı, and too youthful in spirit, even to the his long life, not to feel and to accept influences that were asserting themselves, n his own painting, already presents to us those elements that have been found so in the work of later schools. It was he (as his iographers have reminded us) in the cata- f whose works there is to be found the first ı of a picture that was nothing more than ape. It was he, also, who first gave dignity luence to the profession of the portrait ; and it is by no mere accident that these dern modes of art found such powerful ex- ı at his hands. Their establishment, at me, signalised the exhaustion of the l upon which the earlier and more passion- had employed itself, and gave warning inting was about to make a new return to to regain the freshness and the veracity it t, and, perhaps, one day, to bring back new es of reality, to be moulded once more to pe and colour of our sublimest thoughts. ay has, perhaps, not yet come. From time to our own, the claims of realism en in the ascendant. For 300 years art has rested content with the triumph of imita- ill, and nearly all that has possessed a it aim has been rather artificially grafted ts epoch, and never freely born of the

yet, in this long communion with the s of nature, there is to be found an element for the future. For it is not to be thought that gress of the painter's or the sculptor's craft nts one continuous and steady development. tory of the past, if we read it aright, would ther to show that art is for ever passing ymbol to illusion, and back again from ı to symbolism. The artist, in his relation outward realities of the world, is like a in some new and untilled tract of country, gins by making a clearing for his home, dually transforms what he has won, until it bears, in every corner, the impress of his spirit and the mode of his daily life. And then, when cultivation has done its appointed task, when flowers have grown up in barren places, and patterns of his own devising have been spread over the surface of the land, the adventurous spirit, which had first led him so far from the common ways of men, once more reasserts itself. He begins to weary of the work of his hand, and grows fatigued with the order and regularity which he has so carefully implanted upon the chaos he had found. He sighs for the wilder growths that lies beyond his present domain, until, with quickened energy, and a sense almost of disgust for what he has achieved, he passes once more into the outer tangle of untamed reality, and loses himself, for a while, in the rich luxuriance of a primitive world.

And so it is with the life of art. The glory of art lies in its power to transform the common facts of nature, till they take a colour and passion from the human spirit; but, in this glory, lurk the elements of decay; for what was the living symbol in the minds of one age, becomes in the next a thing of out-worn fashion and uncertain signifi- cance. Little by little, as the dialect perfected by great men falls from common lips, it loses the accent of vitality; and, lesser scholars, trading upon their master's discoveries, are scarcely conscious how far they have changed his language, till the world finds that it is listening to a dead tongue.

When Michael Angelo died, it was vain to hope that those who came after him could carry forward the sublime style which is associated with his name, and his death, therefore, was the signal and the note of the downfall of the glorious art of Florence. But Venice had never, from the first, so closely associated itself with the higher movement of the intellect, and, therefore, the masters of Venice were able to survive the signs of intellectual decay, and were even helpful in forwarding the revolu- tion by which it was succeeded.

We need not deny the imaginative beauty of Venetian painting in order to acknowledge that its essence lay elsewhere, and that its strength depended, not so much upon the expression of ideas, as upon a surpassing beauty in the render- ing of the facts of nature. It was by the studied cultivation, from the first, of these purely natural- istic elements of painting, that the Venetian masters — Titian most of all — were enabled to herald the advent of a new style; and when art passed from Italy to Flanders, the great Flemish painters, with Rubens and Vandyck at their head, could well take from Venice something that should be of ser- vice to themselves. And it was from Flanders—as we have already hinted—that the English school borrowed its first lessons. Just as Holbein, a century before, had introduced among us the earlier and more precise style of portraiture, so Vandyck now came with the attractions of a later style, if not to found a national school of painting, at least to establish a standard of taste that should prepare the way for native painters when the time had come for them to arise.

When Vandyck died, Sir Peter Lely stepped into his place, and Lely, in his turn, was succeeded by Kneller, an artist who enjoyed the honour of having been employed at Court during the reigns of five successive sovereigns. But neither of these painters could be said to have very worthily

carried forward the principles which Vandyck had introduced, and, accordingly, when our native artists—Reynolds and Gainsborough—arose, their advent seemed like a new birth for art in England, as it certainly was a new birth for English art.

This is not the time to insist upon the beauty of the work that these men produced. All that we have to note is, that now, for the first time, England possessed a school of painting of her own, and that the departments in which that school can claim pre-eminence, are those whose supremacy Titian's genius had already forecast.

Gainsborough not only holds an equal place with Reynolds as a master of portrait, but he was, in fact, the founder of the modern school of landscape; and, when he died, Reynolds—his rival—praised him as the greatest landscape painter of his time. But it is curious to note—and that is our principal concern to-night—how these professed students of portraiture were already aware of something that lay outside the range of their work, and for the representation of which English art was not yet fairly equipped. It is almost pathetic to meet, in the writings of Reynolds, a constant reference to the masters of Italy—and especially to the style of Michael Angelo—and then to turn from his writings to his canvas, to note how little trace his ardent desire had left upon the result of his own labours. Now and again—especially in his later life—he has attempted to graft some suggestion of allegory upon the proper claims of portraiture; but, even against the will of the author, the essential attributes of his style will assert themselves, and we cannot but feel that the effort yields only a graceful fancy, that has no power of colouring the image as a whole. We find this tendency in Reynolds, because, apart from his great powers, he was an indefatigable and learned student of art. Familiar with all the victories of imagination, he sought to establish in his own country the traditions of a style that he himself could only love and admire from a distance. If we do not find the same tendency in Gainsborough, it is because he was more entirely a child of his generation, and because he accepted frankly, and without misgiving, the limitation of his age. All that Gainsborough does is done by the force of his own genius, and he had no inclination to linger over passed ideals, which lay equally beyond the range of his powers and the taste of his time. In Gainsborough's paintings we may see an exact and brilliant reflection of the resources then possessed by English art; while, in the painting of Reynolds, we may detect something more; and we are able to note the ambition, if not the ability, of the painter to enter into a wider realm. But, before either of these two portrait painters had begun their work, another artist had arisen, through whom we may say that English painting made its first effort to fit its language to the rendering of intellectual ideas. Whatever may be the faults or limitations of Hogarth's genius, his work at least possesses for us the invaluable quality of sincerity. Entirely free from affectation, and unsupported by the inherited traditions of the schools, it permits us to judge, as well in its achievement as in its failure, of the existing resources of English painting, in the first genuine essay that had been made to forge out of lines and colours the means of intellectual expressio Reynolds, with his learning and high cultu in the work of past schools, was unable, ev when he attempted to touch upon imaginati themes, to conceal those defects of power whic Hogarth's painting always frankly confessed. N one was ever more completely under the guidan of imaginative impulse than the author of th "Rake's Progress;" no one, on the other han can more justly claim the title of a born painte But Hogarth's ideas did not rise to sublimity, an his artistic gifts were still closely confined withi the scope of realistic effect. He succeeded in h fanciful compositions because he did not mis understand or misuse the means at his com mand; and even in those cases where we hesitat to admit the force or the refinement of the inven tion, the result is still saved from insignifican by the beauty and the delicacy of the painting He has so long been praised as a satirist, and s justly applauded for those qualities in his art tha are not of the essence of art itself, that his gift as a painter have either not been sufficiently re marked, or have been absolutely ignored. "As a painter," writes Walpole, "he had but slender merit," a judgment which later taste has partly reversed, though there still remains a vague feeling that Hogarth's work does not possess sufficient beauty to be judged by the highes standard. This feeling is, I think, partly dependent upon a confusion between the though and the measure of its expression: it mistake the occasional coarseness of the theme upon which he is employed for coarseness of handiwork, but although this may be true in so far as it regard the qualities of the design, where the expression mus share all the defects of the thought, it is absolutely untrue as regards the qualities of his painting. As a colourist, Hogarth will bear comparison with the men of his time, and in his knowledge of tone—the law which regulates the strength of colour in position, and the modifying influence of one tint upon its neighbour—he still remains without a rival in our school.

Hogarth, Reynolds, and Gainsborough. These men are the types of what was of genuine growth in the art of their time. Their achievements were the outcome of a sure process of evolution; in their labours they had the support and guidance of a long and unbroken tradition of executive style. How instinctively, by the light of their genius, they were able to measure the resources a their command, and, with the native prudence o genius, refuse to attempt what lay beyond thei powers, we have seen by reference to a differen order of art, which others were vainly seeking t establish. Barry, Blake, and Haydon. Such me belong, we may say, to the church militant of art But it is not to be said of a painter like Barr that, because he fell short of the goal toward which he pressed, that therefore his influenc counts for nothing in the history of our school The time had not yet come for such victories as h sought to win. But whoever hopes for conques in that vast realm of ideal beauty that he saw onl from afar, and with uncertain vision, must striv with something of his noble persistence and un daunted courage. He was the first notable instance in our school, of a painter devoting himself alto gether to the pursuit of a kind of art that offere

hope of great immediate reward. He may, ꞏed, have been misled by ambition, but the alty fell chiefly on himself; and we may forget frailties of his temper—nay, we may even ;ive the faults of his design—in gratitude for grand and austere example which he set to students of succeeding generations.

DISCUSSION.

The Chairman said he should be glad to say a word two, to illustrate a few of the most important points hich Mr. Carr had brought forward, before a vote thanks to him was proposed. The comparative failure Barry had been ascribed to the temper of the times which he lived. Now, it had been his (the Chairn's) lot to see most of the European galleries, and impression made upon him by Barry's pictures was it they were, at any rate, as good as any class of tures of the same time to be found in any of the great ropean galleries. He could not call to mind in the uvre or the Luxembourg, where the French painters of ; period were represented, any paintings which could considered as good or better. He recollected some ff-looking pictures by David; and, without saying at Barry's were perfect, he certainly thought they re equal to anything to be found in the French hool. There were none in the German school of at time so good; the Italian school was as weak water, and the Flemish was open to the same kind criticism. It used to be very much the fashion decry the English school, and within his own collection the French doubted whether there was any nglish school at all, until 1855, when we, for the first me, sent pictures to France; and then they awakened a sort of wonder to the fact that we could show ctures like Landseer's, Mulready's, Leslie's, and hers. They even went so far as to say that if Mulady's paintings were put up by auction in Paris, they ould fetch as high a price as any by French artists. ut looking at what the times were in which Barry lived, hat could be expected? At that time we were plung-g into the American war; how could painting be en-ouraged, when the people were taken up with thoughts f how they could fight with their relatives across the tlantic? A little later, and we had the French evolution, and the political men of those days hought it wise to spend four or five millions in trying o put it down. How could you have paintings in such a me? Then came a series of Irish rebellions, and then apoleon, with his perpetual wars, and our enorous expenditure to put him down. We had clause in the treaty of Vienna, that no Napoleon ould ever sit on the throne of France, and et he had seen the Queen of England and her Consort Paris, embracing one of the same family, as was the shion amongst monarchs. He thought, therefore, e art of the times was very much influenced by other ings besides art. In the first place, the artist must ve; and if he believed in another world, he must paint ccording to his ideas of that world. At the present me, domestic life in England was the dearest thing we ad, and almost all our pictures were more or less illusations of that domestic life. He maintained that our rt was quite as good as French, German, or Belgian rt, and a great deal better than the Italian. Mr. arr had referred to the difficulties Barry met with regard to painting St. Paul's; but that was not an xperience peculiar to him. After the Prince of Wales ecovered from his illness, and went to St. Paul's to re-urn thanks, the members of the Society subscribed 300 or £400 to put up a memorial window. They got ermission of the Dean and Chapter, obtained a design, nd thought the window was going to be put up. Then ere came a curious set of arrangements for decorating he cathedral, and stopped its adoption. The design of their window represented a miracle above, as the principal subject, and portraits of the Prince and Queen below; but the artist who was entrusted with the grander scheme said that did not suit him at all; he wanted a bigger miracle than their artist had chosen, and from that day to this they had never been able to move a step. There was a force in the Church which could not be overcome, and Barry met with the same kind of difficulty. There was one feature in Barry's paintings which struck him as throwing a light on painters' work in general, and particularly Mulready's, and that was the great earnest sincerity with which he did his best. Almost the last words he heard Mulready utter were these, "If you want to be a painter, you must not spare elbow grease; it is as hard work as anything people have to work for." Miss Amelia B. Edwards, in her admirable novel "Lord Brackenbury," expressed the same idea in these words:—"Art tolerates no divided duty. A man must give his whole soul to it—his whole time—his whole powers of observation, of memory, of comparison, of study. Even so the thing he does must always fall short of the thing he had hoped to do. The greatest painters who ever lived spent their lives, we may be certain, in the vain pursuit of an unattainable ideal. But, at all events, they did so spend their lives. They worked at least as hard as if they had been masons, or plumbers, or joiners." He thought those were words which Mr. Carr himself might have used.

Mr. Hyde Clarke said they must all desire to thank Mr. Carr for the eloquent address he had delivered, and not less to thank the Chairman for his remarks. Perhaps, at one portion of the paper, they might have had the idea that Mr. Carr was underrating Barry in relation to his circumstances and his age, but in the end they must have arrived at the conclusion that he appreciated the artist and his efforts as much as anyone. The question put was, did Barry labour in vain; and did the Society labour in vain in associating itself with Barry in these efforts. It seemed to him that Mr. Carr had, to a great extent, answered that question, and that the Chairman had fully justified the action taken by the Society 100 years ago. It was a long time to look back to, but Mr. Carr had found means to connect their interest even with that remote period. The interesting passage in which he gave the introduction of Martin Archer Shee to the author of the works around that room, brought them into connection with the men of the present day, and the reference to Sir Martin Shee seemed, to a certain extent, to answer the earlier question of the lecturer. He said there was a strange contrast between the two men, and, at that moment, he seemed to indicate a doubt whether Barry had succeeded or failed, and to suggest that he had failed, while Shee had succeeded. Those who had been in Shee's painting-room in the later years of his life, when he was painting portraits at the age of 80, could scarcely consider his career a success. He (Mr. Clarke) remembered Shee saying to him once—"You are often now brought into contact with Mr. Haydon, and he, as a matter of course, abuses the Academy. I recollect when I myself was in difficulties with the Academy. I believe Mr. Haydon's grievance against the Academy is, that on one occasion when he had sent in two pictures to the exhibition, he happened to accompany them, and he heard an Academician call over the staircase to the porter—"Whose paintings are these?" Mr. Haydon's, sir," was the reply. "Mr. Haydon's pictures to the coal-hole!" Shee added that he had a similar adventure. When he was a very young man, and painted some of those great works of genius, which young men are most capable of producing, it so happened that two works he sent to the Academy were rejected, in a year when there were a great many rejected works. The idea occurred to some one of exhibiting all these rejected works, as a challenge to the judgment of the Academy; those who got up the exhibition, sent for his

pictures, and they were to appear; but then it struck him that, after all, though he had been scandalously treated it was perhaps not wise of him, as a young man, to put himself in competition with his seniors, and therefore he sent for his pictures and got them back, not without difficulty, for they were in the catalogue. "Now," he said, "see where Mr. Haydon is, and where I am. I have no doubt if Mr. Haydon had displayed a little more tolerance, he would have been president of the Academy instead of myself." These words had a bearing on the earlier part of Mr. Carr's paper. Which was the man who succeeded—Barry or Shee? Shee enjoyed all the advantages of life; that charm of manner, which remained with him to the last, secured for him every social enjoyment, and advancement in his art to the presidency of the Academy; but he (Mr. Clarke) believed, nevertheless, that the reputation of Barry would remain when the name of Shee would only be remembered by Byron's reference to it? The real test of Barry's position was that which the Chairman had applied to it; he must be judged by the men of his day, and even by those before his day, and he would as willingly compare him with Sir James Thornhill as with any one. At any rate, with careful consideration, no one could fail to arrive at the same conclusion as the Chairman, that in relation to his own day, Barry occupied a truly great position. What did Barry realize? He succeeded no more than Haydon, and than many ambitious men, in accomplishing all the purposes of his ambition, but he did much. He prepared the way for a school of historical art in our own day. He was trammelled by the classical and academical ideas of the day, and those same notions pervaded the French school down to the last works of David. It was only broken by the force of events; although Napoleon was represented as a Roman emperor, it was necessary to present him in his grey coat; it was in reality Napoleon and Wellington who, to a great degree, overcame the tradition of art, and rendered it more natural, and in the respective countries more national. If Barry was not able to do more, they knew by the records of the Society that he was desirous of securing the natural, for there were payments made for models, and every figure was, according to his ideas, presented according to nature. Even if he somewhat failed in his high aims, they must acknowledge his sincere desire to introduce a better element into art. One feature in Barry's work was particularly deserving of notice, that was the introduction of portraits of illustrious men. If there was much absolutely classical, on the other hand how much was there national. He would conclude by moving a cordial vote of thanks to Mr. Carr for his valuable and interesting paper.

Mr. Laing was rejoiced to find that both the Chairman and Mr. Hyde Clarke had spoken in praise of Barry. For the last 50 years he had been in the habit of coming to that room, and those pictures had been lessons to him throughout his life. He was glad also to think there was a movement in the right direction in the Society, and that the cause of art had been brought forward; for he feared that, for some considerable time, they had been paying very little attention to one of the principal objects with which the Society was founded—the encouragement of fine art. He had much pleasure in seconding the vote of thanks, and bearing his humble testimony to the great painter, whose works adorned the walls of the room.

The Secretary (Mr. H. T. Wood) said it might interest the members to see an old volume which the Society possessed, and which he had on the table, containing the MS. of a great deal of Barry's correspondence on the subject of these pictures. It began with the actual letter sent by Barry to the chairman of the committee, stating who the artist was who was willing to undertake the duty of decorating the room, when the ten artists who had been invited had declined. There were many other letters, but, perhaps, the most interesting paper in the volume was an account written by Barry himself of the circumstances which induced him to come forward, and of his object in painting these pictures. When the pictures were cleaned recently, he (Mr. Wood) had made it his business to look through all the old papers, and see if he could collect any facts not already recorded about the pictures. The minutes and other documents, however, had been so frequently gone over before with the same object, that he did not know that he was very successful in finding much that was new, but what little he did find, he put in the form of a pamphlet, which was given to all members who cared to have it. His only object in alluding to it was to say that, coming with no previous knowledge to the study of Barry's history, he could not help arriving at the same conclusion to which Mr. Carr, with his ample knowledge, had been led, as to the extreme sadness of Barry's story. In that room, where they were surrounded by his great masterpieces, where he spent so many hours of hard work, the room to which men brought his dead body that they might pay it some of that tribute of respect which they almost grudged the artist while living, it seemed a pity that they could not awaken more enthusiasm for the artist who was full of such noble aspirations. One could only look back and regret that the fulfilment was not equal to those aspirations. Still the Society of Arts might take some credit to itself for having faithfully discharged the trust left to it by Barry, and for having done what it could for his memory. Even if he had painted the pictures in St. Paul's, which he was so anxious to do, it was doubtful if his fame would have been higher than it was to-day. The Society had always cherished his pictures, and taken such care as it could of them, and now the present Council had undertaken the restoration, the result of which was before them. He would like to add that their Chairman of the evening, Sir Henry Cole, had been a member of the committee appointed to superintend the cleaning, and it was in no small degree to his careful personal attention that so successful a result had been attained.

The Chairman, in putting the resolution, said he had no doubt that owing to this lecture, Barry would be better known than he had ever been before, and that they should not again hear, for many years, the speech made, when some one said he was going to the Adelphi to see Barry—"Barry built the Houses of Parliament, and not the Adelphi." That Society gave prizes and medals for the encouragement of art before the foundation of the Royal Academy, and he could not help thinking that if even the Royal Academy had a series of pictures as good of their kind, or if they could, within a reasonable time, produce a monument of the art of the present day to equal what Barry did in his day they would have reason to be thankful.

The motion having been carried unanimously,

Mr. Comyns Carr, in response, said he would not detain the meeting, except to say that he did not wish it to be thought that he differed at all in his appreciation of Barry, or of the efforts he made, from the speakers who followed him. He cordially agreed with nearly everything that had been said by those who had, perhaps, spoken more effectively in praise of Barry than he had done. He cordially agreed with the Chairman that his achievements were very great in relation to the art of his time. He had no tendency to underrate the value of our English school; he had tried to point out that at the time when Barry was working there were magnificent achievements produced in that school, and if it was not Barry who produced them, it was because an indomitable current of ideas set in another direction, and because Barry, with heroic effort, was fighting against the stream.

MISCELLANEOUS.

MILITARY DRILL.

EXTRACTS FROM THE REPORTS OF HER MAJESTY'S INSPECTORS OF SCHOOLS FOR THE YEAR 1879, SHOWING THE PROGRESS MADE IN INSTRUCTION IN MILITARY DRILL.

"It is to be regretted that military drill is not more frequently taught. Except in towns, there is, I know, some difficulty in the matter, but the managers of schools within a certain area might combine to obtain the services of an army instructor. Many teachers too, who have been volunteers, might, with a little trouble, secure the requisite certificate." — Mr. BERNAYS, Inspector, Durham district, p. 227.

"Military drill is encouraged in a few schools only. Its effect on discipline is always most beneficial, and I could wish to see it more general. It must, however, be smart and good. Slovenly drill is worse than none." Mr. COLVILL, Inspector, Shrewsbury District, p. 240.

"In several schools military drill is taught, and very well taught; it is desirable that it should more often appear in school time-tables. Exercises smartly performed in the playground, generally betoken good order and prompt obedience in the school-room, and they improve the health and carriage of boys and girls."—Mr. DANBY, Inspector, Ipswich and Edmonton Districts, p. 270.

"I notice that big boys and girls are often taught exercises suitable only to infants, and that there appears to be a great dearth of originality in the exercises given to infants. Military drill and extension motions are given with great precision in some of the large voluntary schools in the metropolitan district (Stratford, West Ham, and neighbourhood), and in one or two schools the girls acquitted themselves very creditably in the extension motions."—Mr. HELPS, Inspector, Chelmsford District, p. 301.

"Drill continues to be well taught in all the schools of the Bristol Board, and in a few others."—Mr. MONCRIEFF, Inspector, Bristol District, p. 338.

"Military drill is now taught in all the Hull Board schools, securing at once good physical training and an excellent help to school discipline. In voluntary schools its value is not, I regret to say, adequately recognised." —Mr. STEVELLY, Inspector, Hull District, p. 388.

"The number of schools where military drill is taught continues to increase. I am sorry to say there are very few schools where sufficient attention is paid to 'position drill' in giving a writing lesson."—Mr. CAPEL, Inspector, Warwick and Coventry Districts, p. 235.

LONDON WATER SUPPLY.

The evidence taken by the Special Committee of the Society of Arts on the means of protecting the metropolis against conflagration, in 1874, as to the economies derivable from the consolidation of the water companies, entirely bore out the conclusions taken as a basis by Mr. Edmund Smith, and was subsequently referred to in the discussions before the Parliamentary Committees on London Water Supply. In the last report of Lieutenant-Colonel Frank Bolton, the water examiner, which has just been issued by the Local Government Board, later corroborative evidence as to economies consequent on consolidation is brought forward. Colonel Bolton summarises these advantages under the following six headings:—

1. Unification of the metropolitan water supply will ensure a better supply of water, both as to quantity and quality, on more economical terms, and, consequently, at cheaper rates, than can be afforded by several independent companies.

2. It will ensure the introduction of constant service at an earlier date, and at a cheaper cost of alteration and adaption of fittings.

3. It will effect a saving immediately of about half a million sterling, by rendering new works proposed to be carried out unnecessary, and will utilise, for districts requiring extensions, the spare power now existing in other districts.

4. By the re-distribution of several districts into zones of levels, not only will the supply be better regulated, and waste prevented and controlled, but a great saving will be effected in pumping and other distributory expenses, in addition to the economy secured by consolidation of administration.

5. It will enable the metropolis generally, and the heart of London in particular, to be better protected from the effects of fire, by the provision of an ample and an immediate supply of water under pressure, besides the facilities for the concentration of the greatest available pressure on the most valuable and exposed positions.

6. Greater facilities will be afforded to the local authorities in carrying out these sanitary arrangements in their respective districts, which are dependent upon an ample and efficient water supply.

INTERNATIONAL INDUSTRIAL CONGRESS, BRUSSELS.

The Congress of Commerce and Industry was held at the Brussels Bourse, in connection with the International Exhibition. Among the various Governments, that of England was officially represented by Mr. Charles Kennedy, of the Foreign Office, and Mr. John Corbett, M.P. The Congress was divided into four sections:—1, Political Economy; 2, Commercial Law; 3, Industrial Art; and 4, Applied Science, each of which elected its own officers.

The section of Industrial Art was presided over by **M. Charles Buls**, *echevin* of public instruction for the City of Brussels, **Mr. David Sandeman**, of Glasgow, being appointed one of the vice-presidents. The President gave an abstract of a report which he had drawn up at the request of the organising committee of the Industrial Exhibition of Brussels, in 1874, and in which was developed a programme for the founding of a museum of decorative art.

ART LIBRARIES.

This question was introduced by a report furnished by **M. Havard**, in which he classed these libraries as next in importance to lectures and museums.

M. Platteau said that the library of industrial art attached to the Musée Royal, Brussels, was well attended by workmen, who derived great benefit from it.

The members generally agreed in the advisability of forming a typical library, with as many subsidising libraries as possible, which should generalise art culture.

SCHOOLS OF APPRENTICESHIP.

M. Platteau, Secretary of the Syndicate of Painting, Brussels, spoke in reference to his paper on schools of apprenticeship, in which he states that the question of teaching the various trades imposed itself on all interested in the progress of industry and industrial art. He insisted chiefly on the necessity of founding schools as complements to the workshop, and of choosing the professors from among practical manufacturers.

M. Fourcault observed that industrial instruction, complete and methodical, was now as necessary as literary instruction. Apprenticeship in the workshop was too long, and schools were required to shorten it. He divided industrial instruction into four degrees, according as it was destined for workmen, foremen, or manufacturers. Then he referred to the necessity of popularising instruction in drawing among workmen, who, for the most part, did not understand a plan or a sketch. Those countries which paid most attention to popularising art applied to industry would take the lead.

Signor Vimercati explained that there existed at Florence a school of industrial art, which was not an annexe of the workshop, but masters were requested to oblige their workmen to follow the instruction. This school gave excellent results, as also did those founded by the Roman Railway Company for the study of mechanics.

M. Oreste Lattès, the Italian delegate, said that, in Italy, the Government undertook to bear two-fifths of the total expense of formation, by the municipalities or the chambers of commerce, of all schools of industrial art, the regulations of which it could adopt. The remaining three-fifths were subscribed by the municipalities and chambers of commerce.

Mr. Fison, of Bradford, described the course of instruction at the Kent College, and the Bradford dyeing school, which latter possessed a museum and a library. He considered that the schools could never be a substitute for the workshop.

Mr. Sandeman traced the creation of technical schools in Glasgow, which originated in a meeting held in 1874. A school of weaving was first formed, then one of dyeing. He preferred the school to the workshop, where it was generally supposed that a lad was at once initiated into the difficulties of the trade, whereas really he spent several years in manual work entirely unconnected with it.

M. Platteau, limiting his observations to the decorative arts, would ask the establishment of technical schools of private initiative, the instructors to be chosen among specialists, supplemented by the most skilful workmen.

Herr Steinacker informed the meeting that in Hungary there was very little industrial life; and the Government, in default of private initiative, had been obliged to found and subsidise the schools.

M. O. Lattès, in response to an invitation from the President, gave some details of technical instruction in Italy. It dated from only a few years back; but an excellent measure of the Government had, in a very short time, tripled the number of these useful institutions. Private initiative furnished at least three-fifths of the expenses of erection, the rest being contributed by the Government, who reserved the right of inspection. The workshop school was not favourably regarded in Italy.

M. Schoy, of Antwerp, asserted that the superiority of Paris was chiefly due to the studious character and "ferreting-out" spirit of her industrial artists. The specialist Parisian workman knew the different styles, and frequented the libraries and museums. If the artistic value of English and German manufactures had increased, this was due to the various special publications which had popularised good designs.

M. Limousin, of Bordeaux, was of opinion that the Government should intervene in the foundation of technical schools. England could afford, up to a certain point, to dispense with Government aid, because of her exceptional resources from endowments. He considered the present subdivision of trades a matter for regret, but it would increase with improvements in plant. The workman of the future will not produce, but will tend the machine that works, while apprenticeship will be reduced to the minimum of time. This would permit the workman to change with greater ease both master and trade, which might, in some cases, be very advantageous.

The following proposition was then carried unanimously:—"The Congress expresses the hope that the Government will acknowledge that industrial professional instruction and apprenticeship are of social utility; that, in consequence, they continue to subsidise and encourage the present means of instruction, and provide for this instruction in districts where private initiative has not occupied the ground."

Cheap Carriage of Heavy Substances.

This was the first question dealt with by the Scientific Section, under the presidence of **M. Gobert**, Inspector-General, and formed the subject of three papers. The first, by M. Louis Alvin, government mining engineer, attached to the Ministry of Public Works, described several lines of local interest constructed in Belgium with a gauge other than the ordinary narrow gauge. M. J. Moreau's paper dealt chiefly with the economic side of the question, and advocated the construction, not merely of agricultural, but of rural lines, wherever there are small industries, such as stone quarries, which might be extended by their means. The paper of M. Heinerscheid dealt with the transport of heavy goods by rivers or canals, which, he contended, should be so far improved as to render them capable of performing the services that might naturally be expected from them.

M. Finet deprecated the filling up of the canals, and advocated better organisation, so that they might compete with, or at any rate supplement, the railways.

Telephonic Communication.

This was the subject of a paper by M. E. Bède, formerly professor at the Liége University, in which he traced the history of the telephone, and advocated the formation of companies for undertaking telephonic communication in each town. He recommended the use of phosphor bronze for wires instead of iron, phosphor bronze having four times the conductibility of iron, and being from three to four times as strong as steel. Aerial lines had the advantage of being easily inspected, but the disadvantage of being liable to accident, while underground lines were almost free from accident but difficult of inspection. That inventor would render great service to telephonic communication who should devise a cheap method of constructing underground lines, that should at the same time permit of easy and complete inspection.

M. De Locht considered that the contract should be let by public tender to one company only, on condition that the service should be open to all on paying a fee, as in the case of telegraphs.

M. Evrard thought the monopoly should be in the hands of the State, which would extend the system to out-of-the-way corners that offered no inducement to private enterprise.

M. Desguin thought only one company should work a district, otherwise the subscribers of one company would be isolated from those of another. The stimulus of competition between rival companies would be replaced by the interest the company had in increasing the number of its subscribers by perfecting its appliances and improving its service. He was of opinion that eventually all countries would be covered with a vast telegraphic system worked by their Governments; and to attain this result, the State should, for the present, leave each district free to make its own arrangement for telegraphic communication, and establish general telegraphic lines, which might be connected with the district lines, thus preparing the way for a purchase by the Government of the whole system, when the economical conditions of working shall be ascertained.

he discussion was closed by the following resolution fly affecting Belgium:—"The Congress, being of ion that telephonic communications are of general est, would be glad to see some decision arrived at regard to the granting of concessions."

The Transmission of Motive Power

introduced by a paper contributed by M. Paul eux, engineer to the Musée Royal de l'Industrie, Professor of Physics at the Brussels Technical School, M. H. Evrard, engineer to the Administration of ian State Telegraphs. The authors state that it been generally admitted that electricity could only ved to advantage in controlling, liberating, or ting other forces; but, since the invention of eto and dynamo-electrical machines, and the pro- made in their construction for electrical illumina- the problem of utilising electricity as motive · had re-appeared under a new form. It was no · sought to utilise the chemical energy of the y, so as to transform it into mechanical power, fforts were made to transport an existing me- al force from one spot to another, by means of city. In the same way, large steam-engines nuch more economical than those of small size, power might be distributed to the small indus- n towns at a low rate, by establishing a central ator of electricity, and a suitable system of tors. The use of electricity for the transport of power presented the following advantages:— rection is easy; the conductors may follow very curves, requiring less care than pipes trans- g compressed gases, steam or water; there is no r of explosion, and the air is all the purer for ing. The authors conclude that electricity will t of the utilisation, at no very distant date, of all atural forces, hitherto wasted, such as tides and falls.

Electric Illumination

d the subject of a paper by M. Hector De Backer M. Pierre Desguin, Government Mining Engineers, hich they start with the proposition that a better m of lighting tends to equalise the conditions of ing by day and night, and increase the hours of , thus extending production. The principal quali- which electrical machinery should possess, were: a e yield of electric force with reference to the motive er, regularity of action, small size, low price, easy and economical maintenance. On the sensitive- s of electric light appliances depended the quality of light, the generating machine influencing only the of production. Generally, the economical prob- might be thus stated; for a cost equal to that the light previously employed, what is the se of light supplied by electricity? The limit ried with circumstances and appliances, which r it was for the electrician to select accord- to each individual case. The method now most erally adopted for diffusion was to use a globe, i-transparent on its underside and the rest trans- nt, the rays from which were reflected. The ability arising from electrical machines would inish as their construction improved; but that ing from want of homogeneity in the carbons could er be entirely prevented. The lamp should not only perfect itself, but also serve as a compensator to the r irregularities. After describing the various lamps, dles, and regulators, the authors state that, if the bons were homogeneous, the greatest perfection ld be attained by the presence in the circuit, before lamp, of an independent regulator, which should ays allow the same quantity of electricity to reach light, or the presence of an appliance for abstract- the surplus, if the light were regulated for a mini- m of electricity. As to colour, the electric light tained a certain amount of violet rays, which were red to exert an excellent physiological action, though their influence on the sight was not yet determined. The white colour was perplexing rather than disagree- able; and, for the present, until the eye became accustomed to it, yellow substances might be introduced for absorbing the violet rays. The electric light left the most delicate shades of the same appearance that they have by daylight, it illuminated without heating, and also left almost all the oxygen in the air for respiration.

International Legislation as to Work.

Dr. De Paepe addressed to the Scientific Section a letter, which was ordered to be recorded on the minutes, stating that all academies of medicine, and hygienic societies were unanimous in denouncing, as injurious to public health, and the development of the industrial capacity of operatives, the too early work of children, the absence of a thorough apprenticeship, the exercise of certain trades by women, a too prolonged or intense labour by men, the use of poisonous or injurious substances, inefficiency of ventilation, &c. Certain countries had reformed some of these abuses, but not all; and other countries did not adopt stringent regula- tions for fear that they should be beaten in competition by those not subject to the same restrictions. He begged that a proposal to take these subjects into serious consideration, with a view to bring about uniform international legislation, such as that which regulates the post, quarantine and maritime navigation, be placed upon the order of the day of the next Industrial Congress.

The Congress terminated by a series of excursions to the principal centres of industry in Belgium, including Antwerp, with its new harbour works, Liége and the Cockerill Ironworks, the Vieille Montagne Zinc Works, the Val St. Lambert Glass Manufactory, Verviers with its cloth works, and the new dam at Gileppe for the waterworks, Ghent, Bruges, and Ostend.

CITY TECHNICAL INSTITUTE.

The first report of the City and Guilds of London Institute since its registration has just been issued. It is in the form of a report by the council of the institute presented to the governors, and adopted by them at the meeting held on the 8th of November. The meeting was held in accordance with one of the regulations of the institute, which required that there shall be a formal meeting of the governors within four months of the date of registration. The institute having been regis- tered on the 9th July, this period expired on the 9th of this month. The report states that the institute has agreed with the Commissioners of the 1851 Exhibition for a site for their future central institution. The Commissioners have granted to the institute a lease for 999 years, at a nominal ground-rent, of a plot of land about 300 ft. long by 110 ft. deep, in Exhibition-road, between the temporary French and Belgian courts, and close to the South Kensington Museum. Mr. Ruther- ford Waterhouse has been selected as architect, and has been instructed to prepare plans. The report then goes on to refer to the other action of the institute, the details of most of which have appeared in previous reports and in the newspapers. The institute is assist- ing University College, King's College, the School of Art Wood-carving, the Mining Association of Devon and Cornwall, the Nottingham Institute, Artisans' Institute, the Union of Lancashire and Cheshire Insti- tutes, and the Horological Institute. Some progress has been made towards the erection of a technical college in Finsbury, the council of the institute having agreed with the Cowper-street Schools for the lease of a plot of ground on which the college will be built. The report also gives an account of the progress which has been made in the technical science classes held at the Cowper-street Schools, and in the School of Technical Art, South London.

STATE INSTRUCTION IN DRAWING IN FRANCE.

The report of the Commission upon the instruction in drawing in the French "lycées" and colleges, dated June, 1880, has been lately printed and circulated. It is addressed to the Chamber of Deputies, with whom rests the adoption of the reforms proposed. M. Delaborde is the "President Rapporteur" of the Commission. The system of instruction, which is recommended for adoption in France, is based upon convictions very similar to those which carried the reform in England, of the schools of design, in 1852. Upon the occasion of the opening of an elementary drawing school, at Westminster, in June, 1852, the Right Hon. James Henley then presiding, Mr. (now Sir) Henry Cole delivered an address, in which he showed how the schools of design, instead of teaching the principles and practice of applied art, had been compelled, after 14 years' existence, to virtually commence their careers again, in the character of "mere drawing schools." It had taken the long period of 14 years to arrive at the conviction that, in order to educate a competent designer, the obligation could not be avoided of teaching the very elements of the art—a power of drawing. Under the inspiration of this experience, an official syllabus of instruction in drawing, issued by the Department of Practical Art, then located in Marlborough-house, was prepared by Mr. Redgrave, R.A. Elementary drawing was prescribed to be the imitation of right lines, then of curves, then of copies of leaf forms, the whole forming a first course of what was styled geometrical freehand imitation. As a completion of this first course, the student had to learn some elementary geometrical drawing. He was then deemed sufficiently prepared to enter upon a course of drawing from solid examples of simple form, and to complete his knowledge in this section, he was expected to acquire the rudiments of linear perspective. This initiatory instruction in drawing has, since 1852, remained in force throughout the numerous schools of art and art classes throughout the United Kingdom, which are recipients of Government grants for drawing from the Science and Art Department. Bearing these few facts in mind, the agreement of opinion established between English reformers of a State system of drawing thirty years ago and French reformers at the present time, gives increased interest to the report of the French Commission, which runs as follows:—

"Gentlemen,—The problem which is now submitted to you has, in the course of late years, received close attention, and was nearly solved by the members of the 'Conseil Superieur des Beaux Arts' as well as by those who formed the 'Conseil Superieur de l'Instruction Publique.' After interchanging observations and discussing various projects, after labours of successive Commissions composed of both 'Conseils,' an agreement was arrived at upon modifications to be applied to the system of drawing in force in the establishments of the universities, and upon the compilation of syllabuses, according to which the re-organisation of this system should be carried out.

"In order to give early satisfaction to wishes which had been expressed, as well as to ascertain the precise scope of the action to be taken, the predecessor of the Minister of Public Instruction appointed a certain number of inspectors of drawing, whom he charged to proceed with an inquiry upon the present state of affairs in the 'lycées' and colleges, and upon the wants for which fresh measures might be found necessary. All the reports containing the results of this inquiry, undertaken during the first six months of 1879, pointed to the urgency of important reforms. They confirmed what had been previously indicated as being vices or insufficiencies of organisation, and demonstrated the seasonableness of appeals which, from time to time, had been urged for administrative solicitude.

"The Minister of Public Instruction and Fine Arts a once took notice of the reports addressed to him by th inspectors. By a decree, dated 9th July, 1879, th Minister directed a Special Commission to prepare, fo submission to the Conseil Superieur de l'Instructio Publique, a project for organising the instruction i drawing in the 'lycées' and colleges; and by th 6th August, 1879, this Commission accomplished it task. The programme, or syllabuses of instructio prepared by a sub-Commission, especially nominate for the purpose, were approved, on that date, by th entire Commission itself.

"It is these programmes, or syllabuses of instructio that the Commission, to which I have the honour c being the reporter, has been charged to examine. I generally adopting them in principle, the Commissio which embodied them has not felt itself bound t adhere strictly to the text, or to accept all the propose details. As the Commission, which had in truth initiate the projected reform, it naturally approved, and re commended the 'Conseil Superieur' to do so as well, c a method of instruction which, contrary to usage c long standing, should be based upon giving precedenc so to speak, to the training of the eye before that c hand, a method by which young people woul be induced to consider primarily the essential mean ing of the forms; and thus, it was decided that pupi should commence their instruction with linear c geometrical drawing. However predominant such method should be during the three first years c instruction, the Commission had no intention of close circumscribing the practice of young drawers to the me tracing of lines, or of estimating the value of their rel tions one with another. Your Commission was of opinic that, during the first three years' course of instructio opportunities should be afforded the pupils of practical applying the principles they learnt, and that elementa lessons upon drawing or ornament, the representati of objects according to their appearance, could l usefully given. In this way, whilst deriving real profi the pupils would be interested in their work, in a way t prolonged exercises in simple drawing of lines could n be expected to affect. Instruction in drawing then, the 9th, 8th, and 7th classes, would have characteristi of, and should be confined to, the limits we have ju indicated; that is to say, the aim of it should be imit tion and logical appreciation of right lines, a lit later of curves, and later still, the representation objects involving the simplest geometrical drawin and the elements of perspective.

"Work of a slightly advanced sort would be requir of students in the sixth class. Not only would su have to practice themselves in geometrical and in shad perspective drawing, of geometrical solids, and of a f common objects, but they would be required to ma drawings from ornament in relief, taken from conve tional and non-natural objects, such as moulding classic honey suckles, dentated ornaments, &c., an from bas reliefs, inspired by examples of living for such as leaves, ornamental flowers, &c.; but here ag a limit should be fixed, and attempts prevented to imita either in or out of classes, any kind of drawing of t human figure.

"Students should not commence this work until th reach the fifth class, and herein lies an innovation principle which is submitted to you. This innovati gentlemen, the majority of your Commission does n any longer hesitate to propose; but I am desired state that in the former Council, and in many Comm sions preceding the present, a minority, often, it is tr of very small numbers, was opposed to the princi which the majority of your Commission has seen fit adopt.

"To justify objections against any system of init instruction in geometric drawing, the authority, b

of traditional practice of masters of all epochs, as well as of certain precepts, was quoted; against which, nevertheless, it would be easy to adduce other authorities in an opposite sense. Amongst any who had facility in handling the pencil, the necessity was pleaded of developing, from early infancy, the sentiment of the beautiful, of taste, of æsthetic appreciation of form. Now the human figure, such as we see it represented in monuments of antique statuary, and in the works of the masters, being an expression of superior beauty, it was held that the best thing to be done was to bring under the eyes of pupils from the very first day, to the exclusion of all else, models, engravings, photographs, or casts, taken from antique sculptures, or the *chefs d'œuvre* of painters of the Renaissance.

"The holders of a contrary opinion—that is to say, without exception all those of the Commission or abovementioned 'conseils,' who follow the profession of artist—insisted upon the absolute necessity of there being a primary or grammatical course of teaching drawing. 'Since drawing serves as a mode of expression, in the Fine Arts,' said M. Guillamne, one of the most distinguished members, 'one concludes that art is its unique object, and that it is art which should be aimed at before all other instruction. Nevertheless, one finds that its useful, practical side, the means of precision which it obtains from science, and which serve as indispensable supports, even to the artist himself, are disdained. Before knowing how to draw a line and to recognise in it exactly its value, an affectation for ideal beauty is pretentiously set up. Is there not danger in thus appealing to the creative faculty and independence of sentiment when it would be wiser to attend to the ordering and discipline of the rational faculties? As little as a child may do in a course of instruction in drawing, it would be well for him to imbibe some sure notions, precise and practical, which may serve him during his entire life.'

"Your Commission, gentlemen, in preparing the syllabuses which are herewith submitted to you, has been animated by sentiments like those above expressed; it has had in view the progress of national intelligence.

"Instead of efforts, premature, and necessarily futile, in the presence of objects beyond their comprehension and age, the Commission proposes that beginners should work out very simple exercises, such as almost constitute an elementary mathematical apprenticeship. Instead of a system of instruction subordinated to the preferences or personal conveniences of professors, the Commission asks you to sanction, for general instruction, the establishment of a fixed doctrine, of a curriculum of progressive and scholastic study of drawing. It asks you to disengage the study of drawing from useless difficulties in which it has become environed, and to formularise and renovate its conditions; in a word, to substitute rational and thorough investigation for routine habits, or mere facility of the hand.

"Is it necessary to dwell upon abuses which, in many classes of drawing, have obtained a kind of legal force? It seems that students have too frequently been subjected to trials of patience in a specious mastery over the mysteries of hatching, stumping, or stippling. Here, imbued in the victims of this sad method, is to be found the origin of that disgust, or, at least, weariness of work, which has gone on developing during successive years of study. Something worse than ignorance has arisen, false judgment and complete incapacity, even amongst such as may be naturally endowed to conceive and represent the truth, are the outcomes of this vicious method. Let the most distinguished student in drawing, in his 'lycée' or college, be asked to copy no example dedicated to the glory of *crayon manié*, but a real, solid, object, and unless he be permitted to resort to the mendacious eloquence and babble of the style of drawing he has studied, he must find himself totally unprepared to do as he is told.

"To suppress such artificial customs, to rid, as far as possible, instruction of conventionality, we propose, gentlemen, to set our faces against drawing from the human head until such a time when the pupil, by antecedent studies and acquired experience, may find himself fortified against confusion between the purely mechanical imitation of an example, and the paramount duty of finding out how to faithfully reproduce its essential characteristics.

"It is almost unnecessary to say that the study of drawing from the head having been commenced in the 5th class, that of the entire figure will follow in the more advanced classes. To drawing from the human figure, and to the study of the various parts, will be added in the 4th, 3rd, and 2nd classes, graduated studies of agricultural fragments, of decorative figures, &c. At length, besides developing and applying preceding studies in the classes of rhetoric and philosophy, the new programme proscribes that pupils in both these last-named high classes, shall practise landscape drawing from copies, and, further, if circumstances permit it, sketches from nature, trees, buildings, &c. Circumstances permitting, a few attempts might be made in the rhetorical and philosophical classes in studying the human head from life.

"The syllabus of the drawing courses in classes of special secondary instruction, has not appeared to your Commission, to demand exceptional treatment different from that laid down for classical classes of secondary instruction, excepting, in so far as appertains to work to be done by students in special classes, where, a necessary division arises between drawing done without, and that done with the aid of instruments, and in which architectural or machine drawings of an advanced style forms part of the studies.

"For all other classes, the course of study is common to both sets of pupils. Both will be required to follow the same track, will be subject to the same tests, will study from the same models and copies; photographs on account of their negative character, and being liable to be completely misunderstood by beginners, are rigourously interdicted from the category of examples. The only exception in regard to photographs will be made as respects those from pen and pencil drawings of the masters, because in them, precise lines of the master hand are reproduced, and define such methods of drawing as are not to be expected in photographs from sculptures and paintings.

"The prohibition of photographs as examples, excepting in the cases above indicated, is a step to which your Commission attaches great importance. On this point it has expressed an opinion of conformity with that of the unanimity of the majority of the preceding Commissions. As to the establishment, proposed by the more recent of these, of a course of twenty lessons for secondary special instruction, and of fifteen lessons upon the general history of art, your Commission has been forced to the conclusion that it was impracticable. It has considered on one hand that the two hours allowed in the 'lycées' and colleges for drawing could not, without difficulties, be regulated to admit of the special courses in question, and it feared on the other hand that in the majority of cases the teaching staffs might, in the absence of efficiently tested ability to impart such instruction, as that necessary in a comprehensive history of art embracing all epochs and successive phases of art in different countries, be unable to meet the requirements expected of them.

"I have attempted, gentlemen, to bring together the considerations which have influenced us in determining the choice and compilation of the various articles composing the syllabuses of instruction, upon the adoption of which you are asked to deliberate. I should only add that in deciding to recommend the adoption of a progressive course of instruction in drawing, based upon an elementary training in geometry, your Commission has, beyond such convictions as theory alone

might carry, felt the benefit and utility which arise from a regulated and practical order of stages of instruction.

"From statistics furnished by the Director of Secondary Instruction, it appears that about a third of the students in our 'lycées' are receiving special instruction, and that of the remainder, the half, at least, of the 2nd and 3rd, do not rise beyond the 4th class. 'Thus,' as the Director of Secondary Instruction says, 'the half of our students are destined for commerce, for industrial persuits, for manufactories, either as managers or workmen. Consequently, if instruction in drawing 'the figure from copies' be made the foundation of a scheme of tuition, the half of the students would miss those preparatory courses of precise drawing which are more closely allied to different industrial careers.

"How can one escape from being struck by the gravity of such a danger? The means of avoiding it lies in the very method and projected re-organisation of the instruction in drawing which your Commission recommends you to adopt. This method entails no sort of compromise. The vocation, otherwise exceptional, of those students who may some day become artists is not endangered, since the scientific principles they will acquire the knowledge of, will be certainly called into play. The more general interests of those who in the course of their lives may be called upon to express their ideas by more adequate means than by speech or writing, will not be jeopardised, and finally, from the philosophical point of view, a more precise notion of the conditions and uses of the art of drawing will be disseminated. In a single word, instruction in drawing thus understood and followed, would have the advantage of at once imparting to pupils a logical education, and of usefully preparing the way of their future."

To this report are appended the syllabuses proposed for the various classes in the lycées and colleges, which in a measure correspond with the stages of instruction set forth in the official Art Directory of the Committee of Council on Education.

GUM HOGG AND ITS USES.

Under the name of Gum Hogg, a substance is described in the *American Journal of Pharmacy*, of which it is stated that the botanical source is unknown. It appears to be of a similar nature to tragacanth, taking up a large proportion of water, though it is not absolutely soluble. An experiment in this direction showed that, after being in cold water for twenty-four hours, it swelled up into a soft white transparent mass, occupying the lower half of the vessel in which it was placed; when agitated, the mass showed no disposition to form a uniform mucilage, but separated into small, soft, transparent, and rather granular fragments resembling pounded ice; this subsided at the bottom of the vessel again when it was set at rest. A second portion of the gum, by prolonged boiling with water, gave the same result as obtained with cold water.

The commercial history of this gum in North America is very interesting. It appears to have been introduced into Salem, Massachussets, about thirty years since. At that time Salem was the head-quarters of the East India trade, and this gum came with a lot of tragacanth imported to that place from Calcutta. It was supposed that it might be used in place of tragacanth, as a cheaper article, by the shoemakers. It, however, came into the hands of a noted drug garbler of the place, and was rejected by him immediately as an inferior gum. It was next shipped to Boston for sale, and after a number of ineffectual attempts to foist it on the market, it was finally put up at public auction and sold for two or three cents a pound to one of the principal booksellers. The purchaser made a number of ineffectual attempts to utilise it for different purposes, and finally, somewhat disgusted, placed it in the hands of a Prof. Jackson, a chemist, in the neighbourhood of Boston; he made several experiments with it, and discovered its property of forming a good non-adhesive mucilage, when boiled with an alkali. It was soon after utilised for the manufacture of marbled paper, which was just then becoming known in the country. Gradually the secret became known, and as there was a slight demand for the article at different times, small lots were brought into the country. Up to the time of the experiments being made the gum had received no name, but aferwards it was known through the trade by that of gum hogg, and it is believed that the name was given by Prof. Jackson, on account of its obstinancy in resisting the different efforts for its solution, and thus behaving like a well-known animal of similar perverse and wilful habits.

Of late years, the gum has gone considerably out of use on account of the irregularity and scarcity of the supply. The process in which this gum takes a part in the manufacture of marbled paper consists of staining the paper and the edges of books in a variegated manner. The gum is first allowed to soak in cold water until swollen, and then boiled with a weak solution of pearlash until a thick consistent mucilage is obtained, which is strained. This forms the basis or vehicle for receiving the colours and transferring them to the paper, and is placed in a shallow tank about five feet long, three feet wide, and four inches deep. This body must be removed as often as fermentation in the mucilage renders it liquid. In cold weather this is not so frequent, but in hot weather it must be replaced with fresh at least twice daily. The colours used are the ordinary paint colours ground to a cream with thin mucilage of gum arabic. The workman standing over the tank first takes a large brush with spreading bristles, and, dipping it in his colour, sprinkles it over the surface of the tank by twirling the handle between his hands. The value of the mucilage is now shown, for the colour does not either mix with it or spread over its surface, but retains the circular form the drops would assume upon first striking a plane surface. The first colour is then followed in a similar manner by a second, using a fresh brush, and thus in turn by a third, and so on, at the pleasure of the operator, each particular drop showing no disposition to mix with its fellow. The pattern thus made is mostly of round drops, but should it be desired to vary it, combs of different degrees of fineness are drawn in different directions gently over the surface, producing beautiful wavy lines and figures. The paper is now floated gently over the surface of the tank for a few seconds, where the colour is transferred from its surface to that of the paper, and, after being hung to dry, is burnished by hot steel rollers; no particular quality of paper is needed, the only requisite being it should not be too highly calendered. A smooth piece of board is now drawn over the surface of the tank, when it is ready for a fresh operation. The edges of the books are stained in a similar manner, the book being taken unbound and pressed between boards tightly together, so that none of the colour shall penetrate beyond its surface; they are afterwards, when dry, burnished by a hot iron tool by hand. The products afforded by the process are of infinite variety, and, as can be imagined, no two products are ever exactly alike, and, by varying the colours, an almost endless kaleidoscopic change can be produced.

THE MANUFACTURE OF PORCELAIN IN KIANGSI.

The province of Kiangsi has, for some time past, been celebrated for its production of chinaware, and the trade in this article is steadily increasing. The great bulk of it is carried in native craft direct from the factories to various points in China, up and down the

River Yang-tse-Kiang, and along the coast even as far as Canton; a large quantity is shipped *viâ* Kiukiang for Shanghai for transhipment to northern ports, but chiefly Tientsin. The great factories for the manufacture of chinaware are at a place called Kingtê-chên, but it is a curious fact that none of the clay employed is found in that district; this is all imported from districts in the neighbourhood of Nankang-fu, Kwangsin-fu, and Jaochow-fu. The chief reason for the selection of Kingtê-chên as a site on which to erect porcelain factories so extensively, was on account of the water found there, which, because of its cleanness and clearness, and being impregnated with salts, was considered most fit to purify and refine the clay, and unite its particles. It is said that this clay is a composition, and that two or three hundred years are required to prepare it; this, however, cannot be so, as in that case, the ware would be neither so common nor so cheap. It is conveyed from the various quarries in the district by boats and small junks, and washed, in order to purge it from any different earth, then brayed to a small powder, which the workmen continue pounding for a long time. Of this powder a paste is formed, and this is kneaded and beaten in order that it may become softer, and that the water may be incorporated with it. After the clay is thoroughly moulded, it is formed by the wheel into any shape or style that the maker pleases. When the work is satisfactory, the vessel is exposed to the sun morning and evening, but removed as the day gets warmer for fear of its being warped. The various articles are thus dried by degrees, and as soon as the ground is considered fit to receive colours they are painted, and in order to give the vessels and colours a better lustre, or a highly enamelled appearance, a very fine layer of the same porcelain is made, and the whole work washed with it. This gives that particular whiteness and lustre to be seen in the very finest ware. The next process is to put the articles into a furnace, and bake them with a constant but gentle heat, which will not break them. After they have acquired the proper consistency, they are allowed to remain some time before being withdrawn, to prevent any damage by a too sudden exposure to the cool air. The value of this chinaware depends very much upon fancy; but it is generally conceded that three things combine to make any one of the articles complete, viz., the fineness and rare finish, the painting and designing of the figures, and the shape and fashion of the work. The fineness may be tested by the transparency which is discernible chiefly about the edges of the article. The whiteness is often confounded with the varnish, but it is said that age in time makes a plain distinction, for the varnish will tarnish in the long run, and the whiteness becomes more apparent. The smoothness and fineness consist in the brightness of the varnish and evenness of the work. The former must not be too thick, because in that case there will be a crush upon it, and it will shine too much, and the surface is only perfectly even when it has not the least rising or the smallest depression to be seen, although few pieces are without some of these defects. In colouring the chinaware, imperial yellow, milky white, red, and grey are the favourite grounds on which are painted figures, landscapes, flowers, trees, birds, and arabesques, though turquoise blue, pale pink, mazarine blue, and sage green grounds are often employed. Arabesques are more frequently met with than any other style of ornamentation, and they are generally in borders, but are also used for enriching the whole surface of vases, consisting of fanciful and ideal mixtures of all sorts of figures, real and imaginary, often truncated and growing out of plants; also all sorts of plants, and involved and twisted foliage. Many of the designs in painting are mean and common, flowers and trees are often fairly well done, but the figures of men are, as a rule, monstrous, whereas other pictures are bold and well proportioned. The finest specimens are selected by an official for the Court at Pekin, and these are called Imperial ware ("Kuan Yao"), and each article bears a "Kuan Yin" or furnace stamp upon the back, which merely gives the year of the dynasty reigning at the time of manufacture. All the other ware is designated "Min Yao," meaning the ware made for the people; that is of a common kind. Several samples of the Kiukiang porcelain were exhibited in the Philadelphia and Paris Exhibitions of 1876 and 1878.

GENERAL NOTES.

Technical Education.—Sir John Bennett has addressed a letter to several of the morning papers, stating that he is about to bring forward a resolution at the Common Council, that a grant of ten thousand guineas be made to the City and Guilds of London Institute for the promotion of Technical Education. It will be remembered that although the Corporation has always had representatives on the governing body of this institute, they have not as yet contributed anything towards its funds.

Cutlers' Company.—A course of lectures, on subjects connected with the materials used in the manufacture of cutlery, is arranged for delivery in the Cutlers'-hall in December, 1880, and January, February, and March, 1881. The first lecture will be by Sir Henry Bessemer, "On the Manufacture and Uses of Steel, with Special Reference to its Employment for Edge Tools." A subsequent lecture will be given by Prof. Huntingdon, of King's College.

Electric Light Wires.—A letter from Mr. James Harrison, superintendent of the New York Board of Fire Underwriters, dated October 21, is printed in the *Scientific American*, which contains an account of an accident occasioned by electricity from an electric light wire in the office of Messrs. Silcox and Co., of New York:—"One day, either Monday or Tuesday last, some persons on the roof of one of the intervening buildings, dropped an electric light wire upon that of the telephone wire of Messrs. Silcox, bringing the two wires in contact. The effect rather astonished the people in the office. Flames burst forth from the telephone instrument on the wall, producing such an intense heat as to entirely destroy the magnets." The editor points out that such an accident as this may be prevented by covering the electric light wires or the telephone magnets with insulating material, and urges the necessity of this precaution.

Edinburgh School of Cookery and Domestic Economy.—The sixth session of this school, and the first under its extended name, was opened by Dr. Beddoe, F.R.S., president of the Health Section of the Social Science Congress. The subjects to be taught during the session 1880-81 are:—I. Cookery (demonstration and practice). II. Ironing, clear-starching, and the French method of doing up fine lace. III. German method of cutting out dresses, &c. IV. Ambulance lectures on first aid to the injured. V. Physiology and health. A small library of the leading books on food, cookery, and physiology has been formed for the use of students. The Hon. Secretary is Miss Guthrie Wright, 6, Strandwick-place, Edinburgh.

Porcelain Clays.—Prof. Wurtz, who, a year or two ago, examined some of the so-called porcelain clays used at Arita, found that they were no clays at all in the scientific sense of the term, and hence drew the startling conclusion that the Japanese porcelain is not prepared from china-clay. Many other analyses, however, have been made by Prof. R. W. Atkinson, formerly of University College, London, and now of the University of Tokio. These analyses, which have lately been published by the Asiatic Society of Japan, do not, on the whole, bear out the views of Prof. Wurtz. At any rate they show that the composition of some of the clays of Japan is very similar to that of ordinary Kaolin. One of the Satsuma clays, for example, contains 51·79 per cent. of silica, 30·91 of alumina, and 11·74 of combined water. It is true, however, that some of the other analyses agree with those of Wurtz; indeed, one of them shows as much as 81·86 per cent. of silica. But, notwithstanding such analyses, it is clear that true porcelain-clay is used by some at least of the Japanese potters.—*The Academy.*

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock. For meetings previous to Christmas:—

DECEMBER 1.—"The Photophone." By Professor ALEXANDER GRAHAM BELL. F. J. BRAMWELL, F.R.S., Chairman of Council, will preside.

DECEMBER 8.—"London Fogs." By Dr. ALFRED CARPENTER. EDWIN CHADWICK, C.B., Vice-President of the Society, will preside.

DECEMBER 15.—"The Use of Sound for Signals." By E. PRICE EDWARDS, Secretary to the Deputy-Master of the Trinity-house. Dr. TYNDALL, F.R.S., will preside.

For Meetings after Christmas:—

"Buying and Selling; its Nature and its Tools." By Prof. BONAMY PRICE. On this evening Lord ALFRED S. CHURCHILL will preside.

"Causes of Success and Failure in Modern Gold Mining." By A. G. LOCK.

"The Participation of Labour in the Profits of Enterprise." By SEDLEY TAYLOR, M.A., late Fellow of Trinity College, Cambridge.

"The Gold Fields of India." By HYDE CLARKE.

"Flashing Signals for Lighthouses," By Sir WM. THOMSON, F.R.S.

"The Present Condition of the Art of Wood-carving in England." By J. HUNGERFORD POLLEN.

"Five Years' Experience of the Working of the Trade Marks' Registration Acts." By EDMUND JOHNSON.

"Trade Prospects." By STEPHEN BOURNE.

"The Manufacture of Aërated Waters." By T. P. BRUCE WARREN.

"The Compound Air Engine." By Col. F. BEAUMONT, R.E.

"Improvements in the Treatment of Esparto for the Manufacture of Paper." By WILLIAM ARNOT, F.C.S.

"Deep Sea Investigation, and the Apparatus used in it." By J. G. BUCHANAN, F.R.S.E., F.C.S.

"The Discrimination and Artistic Use of Precious Stones." By Prof. A. H. CHURCH, F.C.S.

"Forest Conservancy in India." By Sir RICHARD TEMPLE, Bart., K.C.S.I.

"The Tenure and Cultivation of Land in India." By Sir GEORGE CAMPBELL, K.C.S.I., M.P.

"Indian Agriculture." By W. R. ROBERTSON.

"Trade Relations between Great Britain and her Dependencies." By WM. WESTGARTH.

"The Languages of South Africa." By R. CUST.

"The Loo Choo Islands." By Consul JOHN A. GUBBINS.

CANTOR LECTURES.

Monday Evenings, at eight o'clock. The First Course, on "Some Points of Contact between the Scientific and Artistic Aspects of Pottery and Porcelain." Five Lectures, by Prof. A. H. CHURCH, M.A. Oxon., F.C.S.

LECTURE II.—NOVEMBER 29.

Vitreous, plumbiferous, boracic, and felspathic glazes and enamels. Iridescent and metallic lustres, and colouring substances.

LECTURE III.—DECEMBER 6.

Stoneware and other wares glazed with salt.

LECTURE IV.—DECEMBER 13.

Soft paste porcelains, European and Oriental.

LECTURE V.—DECEMBER 20.

Hard paste porcelains, Chinese, Japanese, and European.

The Second Course will be on "Watchmaking," by EDWARD RIGG, M.A. Three Lectures.

The Third Course will be on "The Scientific Principles involved in Electric Lighting," by Prof. W. G. ADAMS, F.R.S. Four Lectures.

The Fourth Course will be on "The Art of Lace-making," by ALAN S. COLE. Three Lectures.

The Fifth Course will be on "Colour Blindness and its Influence upon Various Industries," by R. BRUDENELL CARTER, F.R.C.S. Three Lectures.

ADMISSION TO MEETINGS.

Members have the right of attending all the Society's meetings and lectures. Every Member can admit *two* friends to the Ordinary and Sectional Meetings, and *one* friend to the Cantor Lectures. Books of tickets for the purpose have been issued to the Members, but admission can also be obtained on the personal introduction of a Member.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, Nov. 29TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Prof. A. H. Church, "Some Points of Contact between the Scientific and Artistic Aspects of Pottery and Porcelain." (Lecture II.)
British Architects, 9, Conduit-street, W., 8 p.m. Mr. E. C. Robins, "Sanitary Science in its Relation to Civil Architecture."
Institute of Actuaries, The Quadrangle, King's College, W.C., 7 p.m. Presidential Address, by Mr. A. H. Bailey.
Medical, 11, Chandos-street, W., 8½ p.m.

TUESDAY, Nov. 30TH...Royal, Burlington-house, W., 4 p.m. Anniversary Meeting.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Renewed Discussion upon Mr. Maxwell's Paper, "New Zealand Government Railways," and on Mr. Mosse's Paper, "Ceylon Government Railways."
Zoological, 11, Hanover-square, W., 8½ p.m.

WEDNESDAY, DEC. 1ST...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Prof. Alexander Graham Bell, "The Photophone."
Geological, Burlington-house, W., 8 p.m.
Entomological, 11, Chandos-street, W., 7 p.m.
Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m. 1. Mr. C. B. Allen, "Note on the History of Saffron." 2. Mr. E. M. Holmes, "The Use of Saffron in Pharmacy."
Archæological Association, 32, Sackville-street, W., 8 p.m. 1. Rev. Dr. Hooppel, "The Explorations of the Roman Station of Vinorium (Binchester)." 2. Dr. Wake Smart, "Roman Remains at Nursling, Hants."

THURSDAY, DEC. 2ND...Antiquaries, Burlington-house, W., 8½ p.m.
Linnean, Burlington-house, W., 8 p.m. 1. Mr. Frederick Townsend, "An *Erythræa* new to England." 2. Dr. Maxwell Masters, "The Conifers of Japan."
Chemical, Burlington-house, W., 8 p.m. 1. Mr. W. Ramsey. "Communication from the Laboratory of the University College, Bristol." 2. Laura Maude Passavant, "The Specific Volume of Chloral." 3. Mr. J. W. Hamilton, "The Formation of Carbon Tetrabromide in the Manufacture of Bromine." 4. Ballot for the Election of Fellows.
South London Photographic (at the HOUSE OF THE SOCIETY OF ARTS), 8 p.m.

FRIDAY, DEC. 3RD...Philological, University College, W.C., 8 p.m.
Geologists' Association, University College, W.C., 8 p.m.
Archæological Institute, 16, New Burlington-street, W., 4 p.m.

NAL OF THE SOCIETY OF ARTS.

No. 1,463. VOL. XXIX.

FRIDAY, DECEMBER 3, 1880.

...nications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

THE PHOTOPHONE.

...ection of the diagrams used by Professor ...ı Bell, to illustrate his paper on the Photo-... will be reproduced in next week's *Journal*. ...as not been sufficient time to allow of the ...being prepared for the present issue.

CANTOR LECTURES.

...econd lecture of the first course was de-... on Monday, the 29th ult., by Prof. A. H. ..., M.A., F.R.S., on "Some Points of Contact ...ı the Scientific and Artistic Aspects of ... and Porcelain." The lecture was devoted ... treatment of glazes, enamels, lustres, ...louring substances. The lectures will be ... in the *Journal* during the Christmas recess.

...TICAL EXAMINATIONS IN VOCAL AND INSTRUMENTAL MUSIC.

...next examination at the Society's house ...held during the week commencing January ...881. Particulars will be forwarded on appli-... to the Secretary, Society of Arts, John-... Adelphi. No names can be received after ... December, 1880.

...EEDINGS OF THE SOCIETY.

THIRD ORDINARY MEETING.

...esday, December 1st, 1880; F. J. BRAM-... F.R.S., Chairman of the Council of the ... in the chair.

...ollowing candidates were proposed for ...as members of the Society:—

...ra., 26, St. Peter's-square, Hammersmith, W.
...mas, 9 and 10, Baker-street, Portman-sq., W.
...homas, Church Entry, 75, Carter-lane, E.C.
... Godfrey Charles, 22, King-street, Portman-... W.
Macauley, Lieut.-Colonel George William, 43, Craven-road, W.
Stubs, Peter, Statham-lodge, Warrington.
Symmons, Edmund, Eagle-house, Bermon-hill, Woodford.
Walker, Robert, J.P., Kidwells park, Maidenhead.
Waterhouse, Sebastian, 37, Catherine street, Liverpool, and Windham Club, S.W.
Williams, William Henry, 23, Holland-park, W.

The following candidates were balloted for, and duly elected members of the Society:—

Allcock, Arthur Thomas, 5, Spring-gardens, Newark-upon-Trent.
Atkinson, Frederick William, 137, Leadenhall-street, E.C.
Aylmer, Capt. John Evans-Freke, M.P., Aylmersfield, Streatham.
Baillie, J. H., 15, Old Bond-street, W.
Baxter, F., South Eastern-wharf, Park-street, S.E.
Bell, R., 83, Knightrider-street, E.C.
Bennet, Peter Duckworth, Edgbaston, Birmingham.
Biggs, Benjamin, 3, Laurence Pountney-hill, E.C.
Blackwood, Richard, 96, Cromwell-road, South Kensington, S.W.
Blamires, Thomas Howard, Close-hill, Lockwood, near Huddersfield.
Blyth, James, 31, Park-terrace, Regent's-park, N.W.
Capel, Frank C., The Mount, Wilmington, Kent.
Carpmael, Alfred, 1, Copthall-buildings, E.C.
Clark, William Timbrell, Kilsby, near Rugby.
Collington, James B., Beeston, Nottinghamshire.
Comerma, Capt. Andrés A., 48, Macfarlane-road, Shepherd's-bush, W.
Cottew, William Stokes, The Bank, Tottenham.
Cranwell, William B., 42, Portsdown-road, W.
Crookenden, Isaac Adolphus, Marlborough-house, Blackheath, S.E.
Deane, James Parker, D.C.L., Q.C., 3, Paper-buildings, Temple, E.C., and 16, Westbourne-terrace, W.
Deaville, Rev. Joseph Gibson, Agincourt-villa, Bury, Lancashire.
Dewrance, John, 176, Great Dover-street, S.E.
Eaton, Francis James, Albert-road, Hesketh-park, Southport, Lancashire.
Emptage, Daniel, Dane-hill Sanitary Works, Margate.
Estcourt, Roland M., Local Government Board, S.W.
Evans, Lieut.-Colonel John, Highfield, Derby.
Ford, George Benjamin, 196, Westminster-bridge-road, S.E., and 9, Cuthill-road, Denmark-hill, S.E.
Freeman, William George, 44, Kensington-square, W.
Gordon, Surgeon-General C. A., M.D., C.B., Q.H.P., 70, Cambridge-gardens, W.
Grant, Sir John Peter, K.C.B., G.C.M.G., The Doune of Rothiemurchus, Aviemore, N.B.
Greenall, Lieut.-Colonel James Fenton, Lingholme, Derwentwater, Cumberland.
Guest, Montague J., M.P., 3, Savile-row, W., and Bere Regis, Blandford, Dorset.
Guthrie, Herbert, 32, Brown-street, Manchester.
Hall, Alexander Lyons, F.R.G.S., Lyon's-court, Ladbroke-road, Holland-park, W.
Harper, George Thomas, Southampton.
Harvey, William Charles, 12, Old-square, Lincoln's-inn, W.C., and 8, Warwick-road, Maida-hill, W.
Haynes, F., Superintendent's Office, Telegraph Department, G.W.R., Taunton.
Heyworth, Lieut.-Colonel Lawrence, Wain Vawr, near Newport, Monmouth.
Hickman, Alfred, Goldthorn-hill, near Wolverhampton.
Homan, Ebenezer, Friern Watch, Finchley, N.
Hulse, Joseph, Dresden, Longton, Staffordshire.
Isaac, Benjamin, 102, Piccadilly, W.
Johnson, Walter Claude, Rivoli, Old Charlton, Kent.
Judson, Frederick Henry, 77, Southwark-street, S.E.
Keyser, Charles Edward, M.A., F.S.A., Merry-hill-house, Bushey, Herts

Lambe, J. B., 199, Upper Thames-street, E.C., and 427, New-cross-road, S.E.
Lightfoot, Thomas Bell, 2, Granville-park, Blackheath, S.E.
Lingard-Monk, Richard Boughey Monk, 4, Westminster-chambers, S.W., and Fulshaw-hall, Wilmslow, Cheshire.
Lovell, Richard J., 48, Oakley-road, Canonbury, N.
McDonald, James E., 4, Chapel-street, Cripplegate, E.C.
Marriner, William Tyler, Eton-villa, King Edward's-road, South Hackney, E.
Marshall, Alfred, The Villa, Muswell-hill, N.
Martin, John Cowdery, White Lead Works, Ossory-road, Old Kent-road, S.E.
Mineard, George Edward, 57, Warwick-road, South Kensington, S.W.
Moser, Charles E., Brooklyn, 75, Upper Tulse-hill, S.W.
Neal, James, 21, Lime-street, E.C.
Nyland, James, 42, Burlington-road, St. Stephen's-square, Bayswater, W.
Paddon, Samuel Wreford, Brooklyn, Chislehurst.
Pearson, Joseph Hickman, J.P., The Leveretts, Handsworth, near Birmingham.
Pfoundes, Charles, F.R.G.S., M.R.S.L., 1, Cleveland-row, St. James's, S.W.
Pickering, Charles William Harrison, J.P., New Brighton, Cheshire.
Pinnock, Henry, J.P., Beechwood, Newport, Isle of Wight.
Pursell, John Roger, Kingston-road, Merton, Surrey.
Puzey, William, 5, Aldermanbury-postern, E.C.
Quincey, Edmund de Quincey, 76, Avenue-road, Regent's-park, N.W.
Ravenscroft, Sidney Horace, Powis-lodge, Haverstock-hill, N.W.
Robinson, John, F.G.S., Kingscote, East Grinstead.
Robson, John, Tynemouth-road, The Green, Tottenham.
Rogers, J. H., Moore-place, Esher, Surrey.
Rothwell, Richard, 45, Holland road, Kensington, W.
Rudd, William Albert, Gloucester-house School Science and Art Classes, Dodington, near Sittingbourne.
Simpson, George Palgrave, 2, Mount-terrace, Richmond, Surrey.
Sonnenthal, George, 85, Queen Victoria-street, E.C.
Southee, Arthur Philip, Mount Edgecumbe, Ramsgate.
Squire, John Barret, Worston-house, Durning-road, Liverpool.
Stanger, George Hurst, Queen's-chambers, North-street, Wolverhampton.
Stone, James Henry, J.P., Cavendish-house, Grosvenor-road, Handsworth, Birmingham.
Tarr, William, 83, Knightrider-street, E.C., and Ferndale, Walton-on-Thames.
Trench, Lieut.-Col. the Hon. William Le Poer, R.E., 3, Hyde-park-gardens, W.
Verity, John, 31, King-street, Covent-garden, W.C.
Warrick, Robert Betson, 27, Woburn-square, W.C.
Weager, James H., 26, Leadenhall-street, E.C., and Tottenham.
Weir, James, 49, Jamaica-street, Glasgow.
Wells, Charles A., 1, High-street, Lewes, Sussex.
Wing, John Unwin, Brinkburn-grange, Sheffield.
Wyatt, Vitruvius, Gas Light and Coke Company, Beckton, E.
Ziegler, David, 7, Upper Woodland-terrace, New Charlton, Kent.

The Chairman said it was the duty of a chairman, as a rule, to introduce the reader of a paper to the meeting, but this evening it was quite superfluous for him to do so. He should have to accuse the members of the Society of Arts of want of gratitude, and even of not belonging to civilised society, if he assumed that Prof. Graham Bell required any introduction, because he was prepared to say that Prof. Graham Bell, whose paper on the telephone they had listened to with so much pleasure, two years ago, had made for hims world-wide reputation in all places claiming civil tion. In that room, Professor Bell had, two y ago, brought before their notice an account of telephone, with which they were so much intere They were all, of course, glad to find that he had rested on the reputation he then made, but that he continued the devotion of his mind in that partic direction, the result of which had been the produc of this marvellous instrument, the photophone. would not waste any further time, but simply call Prof. Graham Bell.

The lecture was on—

THE PHOTOPHONE.

By Professor Alexander Graham Bell.

I had hoped to have been a listener here to-n instead of a speaker. While I was uncertain whe my engagements abroad would permit me t present in England, I still intended to make e effort on this occasion to hear Mr. Preece read paper he had promised. I am sorry that circ stances have disappointed me in hearing and speak on this subject; but I need hardly tell how much pleasure it gives me to come a before the members of the Society of Arts.

The facts of science are often more marvel than the imaginations of fiction, and to-nig have to bring before you one more illustra of the truth of this saying. That we shoul able to talk along a beam of light as we through a speaking tube, seems almost too vellous for comprehension; but you are a that everything is easy when you know it is done, and it will be my duty to-night to plain to you the *modus operandi* by which wonderful result is obtained—to show you ho can produce the sounds of articulate speec distant places by the simple agency of a quive beam of light. It will be necessary, how before entering on this subject, to s of the curious discovery that was first nounced to the world in February, 1873, by Willoughby Smith, who discovered that the and curious element, selenium, has its elec resistance affected by the influence of light; when light falls upon selenium a free passa opened up among the molecules of a curre electricity, whereas, in the dark, the resistan this substance is enormous. We know that nium was discovered in the year 1817, the great chemist, Berzelius, in attem to discover tellurium in the residues obt in the manufacture of sulphuric acid. found that it was a non-conductor of electr but Hittorf discovered, in 1851, that sele became a conductor of electricity in one allotropic forms. When selenium is fused, slowly cooled from the fusing-point, it is f to be in a crystalline condition; in this dition it is a conductor of electricity at nary temperatures. To Mr. Willoughby S and to his assistant, Mr. May, is due discovery that I here allude to, that the ductivity of selenium is affected by light hope to have an opportunity of exhibitin effect to you to-night, by throwing on this s a ray of light reflected from the mirror of a Tho galvanometer. A piece of selenium, which i

parabolic reflector at the end of the room, is connected in the circuit with this galvanometer and a rheostat. The resistance of the selenium is balanced, so that the spot of light should not be deflected to any material extent when a current of electricity passes through the circuit; but on throwing light upon the selenium, we shall immediately obtain a marked deflection of the galvanometer; or, in other words, of the spot of light. We shall have to be very still until the spot of light comes to rest, as the slightest movement on the platform will disturb this delicate instrument — the galvanometer. I have in my hands a little mirror, by which I can throw a beam of light on the screen, and if the experiment should prove successful, we shall be able to obtain a deflection of that beam of light. I may say that this is a difficult and delicate experiment, and may not at first be successful, but I hope to obtain a deflection of that spot of light. You observe the moment the light is thrown into the parabolic reflector the resistance of the selenium is reduced, and the deflection of the galvanometer occurs. You will understand that the action of the light is to cause a diminution in the electrical resistance of the selenium, so that the resistance which was balanced while the selenium remained in the dark, was no longer balanced when the light was thrown upon the selenium.

Although, as I have said, selenium was discovered by Berzelius in the year 1817, more than half a century passed before this substance was regarded as anything more than a chemical curiosity. Mr. Willoughby Smith was the first, so far as I know, to attempt to utilise it in the arts. On account of its enormous resistance to the passage of the electric current, he thought it might be used in his system of signalling and testing during the submersion of submarine cables. For this purpose, he made experiments on the Atlantic cable at Valentia, and it was during the course of these experiments that the discovery was made, that the electrical resistance of this substance was affected by light. The mode in which selenium was used consisted of a bar of selenium with platinum terminals fused into the ends for purposes of connection, and placed inside a glass tube, hermetically sealed. When experiments were made on the submarine cable, it was found that the selenium had all the resistance required. Some of the little bars, an inch or two in length, measured as much as 1,400 megohms, a resistance equivalent to that of a telegraph wire long enough to reach from the earth to the sun, but it was found to be extremely variable. In seeking for the cause of this variability, the discovery was made that the resistance varied with the amount of light falling on the selenium. It is not my object to take up your time to-night by describing the interesting researches that followed on this discovery by Mr. Willoughby Smith. You must all be familiar with the researches of Draper, Marsh, Sale, Adams, Sabine, and Siemens. I shall merely direct your attention to one or two forms of selenium apparatus devised by Dr. Werner Siemens. In the first diagram, you will see what is known in America as Siemens's grating, in which the resistance is sought to be reduced by laying two platinum wires arranged in a zigzag form. The whole is covered with selenium, and the current, in passing from one wire to another, has to pass through the selenium. On account of the length of the two wires, the resistance is very greatly reduced. The other form of apparatus is that which is popularly known as Siemens's spiral, in which these two wires, instead of being arranged in a zigzag form, are coiled together so as to form a double spiral, on which is placed a strip of melted selenium. The whole is arranged between two mica plates and pressed together, being afterwards annealed, to produce crystallisation. I am glad that we have here to-night some of the ingenious apparatus devised by Dr. Werner Siemens, and I am also glad that we have upon the platform to-night, Dr. C. W. Siemens, and I hope he will explain to you, and exhibit in operation, the ingenious "selenium eye" that we have upon the platform. In practical experiments with selenium, the enormous resistance is a difficulty; and I shall show you a few forms of selenium cells, devised by Mr. Sumner Tainter, of Washington, and myself. We have been working on this subject for many months past, and have produced selenium cells of such a low resistance, as to be of practical use in experimental work—such low resistance, that we can use them in telephones and galvanometers of ordinary construction. The resistance of selenium cells hitherto employed, have generally been measured in millions of ohms; the lowest resistance I know of has been 250,000 ohms in the dark, but in the form of selenium cells, as shown on the screen, the resistance is only 300 ohms in the dark, and 150 ohms in the light. I will briefly describe the arrangement. If you look at the illustration at the top of the screen, you will see that it represents two brass plates, separated by mica. The upper plate is perforated, and the lower plate has metallic pins attached, which pass through the upper plate, so that their tops are flush with the upper surface of the plate, but do not touch it. You must understand that there are annular cracks round each pin on the upper surface. You will see a plan view of the arrangement in the centre of the diagram. The central circle represents the end of one of the pins, and the larger circle the end of the orifices in the upper plate. The annular cracks are filled with selenium. There is one point to which I will draw your attention, and that is, the conical shape of the perforations in the upper plate. On account of that arrangement, the points of closest approximation between the pins and the plate are upon the upper surface. Now, as the action of light upon selenium seems to be a surface action, this is a special advantage, as throwing the whole current along the surface of the selenium.

The method of annealing selenium which is usually employed is to place the selenium cell in a cylindrical pot with a thermometer, connecting it with a galvanometer and a battery. It is placed inside a pot filled with linseed oil, and the whole is heated over a gas-stove. The temperature rises to about 210° C., and it is retained at 210° C. for many hours—generally about 24 hours in our experiments—and then the whole arrangement—pots and selenium cells—is packed in a box arranged to retard radiation of heat, so that it takes 40 to 60 hours to be cooled down to the temperature of the air. When the selenium

is removed, it is found to be a conductor, and very sensitive to light.

In the experiments of Mr. Tainter and myself, we have devised very many different forms of selenium cells, but it would not do to take up your time by entering too much into the *minutiæ* of this. I shall simply direct your attention to the form of the cell that I am using in my experiments at the present time, a specimen of which is before you now. The selenium cell is cylindrical in shape; in fact, it looks somewhat like a reel of cotton. It consists of numerous brass discs, separated by discs of mica, slightly smaller in diameter than the brass discs. You will understand that when these discs are arranged alternately, you have a large number of annular grooves between the adjoining brass discs and over the edge of the mica; these are filled with selenium, and we have, in this form of cell, about 100 of these selenium rings. By an arrangement, which it is unnecessary to describe to-night, alternate brass discs, Nos. 1, 3, 5, 7, and so on, are metallically connected together, and all the even numbers are connected together, the odd numbers being connected to one pole of the battery, and the even numbers to the other; then the only means for the current to pass is through the selenium rings, and on account of the large number of the rings the resistance of this cell is very small. We prefer the cylindrical shape, because the apparatus can be placed in the focus of a parabolic reflector, and a beam of light coming from a great distance, may be caught by the reflector and brought on to the selenium surface of the cylindrical cell. In selenium cells of the description I have shown you, the resistance is extremely small. An improvement has been made in the method of annealing also. Hitherto the preparation of sensitive selenium has required very many hours, but we can now prepare it in a very few minutes. A cylindrical selenium cell, like that I hold in my hand, is placed in a lathe, and is kept rotating over a gas flame, the cell being protected from the direct action of the flame by a sheet of metal. When the brass is hot enough to melt a stick of selenium applied to the surface, it is rubbed over it, so that we have a uniform surface of selenium. The arrangement is then allowed to cool, but the selenium obtained in this way is a non-conductor, or has a very high resistance. In order to reduce the resistance, and give it sensitiveness to light, we re-heat the selenium over a gas-stove. In the original, amorphous, non-conducting condition, it is black, and shines by reflected light, but as you heat it a remarkable change in its appearance takes place. It crystalises during the heating process, and becomes like frosted silver or lead, or, at all events, it looks like metal. Now, if you continue the heating process at a certain temperature—say 270° C.—this crystalline selenium melts; the moment we observe the first signs of melting, the gas is immediately turned out. No special precaution is taken with regard to cooling the selenium, but it is found on cooling to be a conductor, and to be sensitive to light. Cells of this description have generally a resistance of about 300 ohms, and a sensitiveness of about one-half; that is, the resistance is reduced to-half when it is exposed to a bright light. Prof. Adams has shown that the resistance of selenium is reduced in some proportion to the intensity of the light that falls upon it. One result of his researches was to suggest to my mind, that by varying the intensity of the light falling upon selenium, and observing its conductivity, not with the galvanometer, but with the telephone, we might be able to produce sounds from the telephone. The laws of audibility of the telephone is precisely analogous to the law of electric induction. No sound is produced, so long as you pass a continuous and steady current of electricity through the telephone; it is only at the moment of change from a stronger to a weaker condition, or *vice versâ*, that any audible effect is produced; and the amount of sound is precisely proportionate to the amount of variation in the current. Hence, when a beam of light is allowed to fall on a piece of selenium which is connected with a telephone and galvanic battery, no effect is produced, so long as the beam shines steadily and continuously, but the moment you vary its intensity from a stronger to a weaker condition, or *vice versâ*, you vary the resistance of the selenium; in like manner you vary the strength of the electric current traversing the current; in like manner you vary the power of the magnet in the telephone, the plate of the telephone is attracted or released, and the sound is produced from the plate of iron. If, then, we can vary the intensity of the beam of light in such a manner as to produce variations in the strength of the electric current traversing the telephone, corresponding to the variations in the air produced during the utterance of any vocal or other sound, we shall have produced from that telephone a reproduction of the original sound.

In carrying this idea into execution, it is of course necessary to devise an apparatus by means of which the intensity of a beam of light may be controlled by the voice. Mr. Sumner Tainter and I have devised a large number of forms of apparatus for producing this effect, but I shall only occupy your attention to-night by showing you two of the most successful forms that have been constructed.

In the form of articulating photophone now shown, we have a perforated screen attached to a diaphragm which can be actuated by the voice of a speaker. There are two similarly perforated screens, one behind the other. In the normal condition of the apparatus, the slits in the one screen are almost superposed upon the slits of the other, so that there are slight apertures through which light can be passed, but it will be understood that upon passing bright light through the double screen, and speaking into the apparatus, the movable screen is caused to slide backwards and forwards by the vibration of the diaphragm, thus partially closing and opening the minute orifices for the passage of light. Thus the vibration of the screen, under the action of the voice, controls the amount of light that is passed through. In arranging the apparatus for the purpose of transmitting speech to a distance, a parallel beam of light is employed so that as little dispersion as possible takes place. You can see on the screen the fixed grating and the movable grating attached to the diaphragm. The light is passed through the double grating, and at some distant point is condensed by means of a lense on a selenium cell

which is connected with a galvanic battery and telephone. Now the action of the apparatus will be understood. When a person speaks into the tube, more or less light is allowed to pass through, in accordance with the vibration of the plate. You then have a varying beam of light; the amount of light that reaches the distant station varies in proportion to the motion of the plate; that is, in proportion to the motion of the particles of air that actuate the plate; that is, in proportion to the vibration of the voice; the electric resistance of the selenium being affected proportionately to the intensity of the light falling upon it. Thus we have in the telephonic circuit a constantly varying current of electricity produced, the variations of which correspond to the variations of resistance in the selenium — correspond to the variations in the amount of light transmitted by the double grating—correspond to the variations of the speaker's voice—and we know the result; the articulations of a distant speaker are reproduced by the telephone at the listener's ear, although no conducting wire is found between the transmitter and the receiver. I may say, that in this form of apparatus, Mr. Tainter and I have succeeded in carrying on a conversation when the transmitter and the receiver were separated by a distance of about 280 feet. But a very curious effect of articulation was produced. The articulation reminded me of the early forms of telephone, which were shown to the world in the spring of 1876. In a paper read before the American Academy of Arts and Sciences, in May, 1876, I analysed the pronunciation of the telephone as then constructed, and found that, while the vowels were very accurately reproduced, the consonants were very imperfect. It was the same with this form of photophone, and I will give you an illustration of this peculiarity. The transmitted instrument was placed at the open window of my laboratory in Washington, with a selenium receiver a few feet away, and the telephones connected with the selenium receiver were placed in the basement of the same building, out of earshot. A friend then spoke to the transmitter. I, listening at the telephone in the basement, heard the tones of the voice very distinctly, with a great deal of the articulation; familiar sentences, such as "How do you do?" "Do you hear what I say?" "One, two, three, four, five," and such common phrases as these, were easily understood; but, on asking my friend to repeat sentences of the nature of which I could have no previous idea, I was unable to understand the articulation. On coming upstairs I repeated, as nearly as possible, the sounds that I had heard; that is, I gave utterance to a string of gibberish; but, upon comparing this gibberish with the actual sentence that had been uttered, I found that the vowels in the gibberish were identical with the vowels in the sentence. I then asked my friend to repeat another sentence that I could not guess, and the result was rather amusing, and illustrates this same peculiarity of the articulation. Upon going downstairs, and placing the telephone to my ear, I could hear the sentence, "A good piece of bread; a good piece of bread; a good piece of bread." I listened for about twelve or fourteen times, and this sentence was repeated, and the articulation seemed perfect. I then went upstairs, and said to my friend, "I understood it this time; you said 'a good piece of bread.'" He said; "No; I said—'put me to bed.'" It will be observed that the vowels in these two sentences are the same; the consonants alone were defective. I may say, in passing, that our neighbours on the opposite side of the street, seemed very much astonished at the sight of a young man at an open window, shouting, in broad daylight, "put me to bed."

I shall now have the pleasure of showing you the form of apparatus in which the defects of the articulation have been remedied. We now simply speak against the back of a looking-glass that is made of very thin and flexible material. We use microscope glass, silvered by the ordinary process for silvering specula for the telescope. I am holding one of these in a beam of light, so that you may see the reflection produced by the disc. Upon speaking to this disc, it is thrown into vibration and moved backwards and forwards, becoming alternately convex and concave; and you will observe on the screen the effect produced by simply breathing upon it; the beam of light is alternately condensed and scattered; and the intensity of the light falling on the screen is constantly varying under the vibration, of the plate. I can speak to this, but of course the vibrations are too rapid to be followed by the eye. I shall make a trilled *r*, and I think in this case you will be able to observe the vibrations of the disc. [Mr. Bell here showed the vibration of the mirror under the sound of *rrr*, and also the effect produced by articulating the numerals from 1 to 20.]

You will now understand what I have ventured to term an undulatory beam of light, for want of a better expression. By an undulatory beam of light, I mean light that shines continuously on a sensitive receiver, but the intensity of which upon that receiver is constantly varying, in a manner corresponding to the vibration of some sound. The form of apparatus you have seen shown in section in the last illustration. The speaker's voice is directed against the silvered diaphragm through a speaking-tube; the portion of light striking the diaphragm is reflected as a parallel beam, but, on speaking to the diaphragm, it becomes alternately convex and concave, scattering and condensing the light, and making it what I call an undulatory beam. On arranging the apparatus for the purpose of transmitting speech to a distance, Mr. Tainter and I have found the following arrangement advisable. The actual apparatus by which the result is achieved is shown on the table. A beam of sunlight, or a parallel beam of light from any source, is reflected from a plane mirror through an achromatic lens, and brought to a focus upon or near the diaphragm mirror. After being reflected, the rays are again brought parallel, as nearly as possible, by a second lens, and at a distant station the light is received in a parabolic reflector, in the centre of which is the selenium receiver. It is found in actual practice, in utilising sunlight for this purpose, we are very apt to crack our glass, on account of the great heat at the focal point, and yet we want great concentration of light in order to allow for some loss, because we must have some loss in transmitting to a great distance, so we place the focal point not on the mirror, but near it, and place in the path of the beam a concen-

trated solution of alum, for the purpose of absorbing the heat rays of low refrangibility, to protect the mirror as much as possible. You will understand that telephones are connected with the selenium receiver and a battery. You will also understand that when a person speaks to this mirror, the intensity of the beam of light is constantly changed, the electric resistance of the selenium is constantly changed, and the sound that is taken into the transmitter is reproduced by the telephone in circuit with the selenium.

In experimenting with this apparatus, we have been unable to attempt the reproduction of speech at a great distance on account of the necessary privacy of our experiments; but we have succeeded admirably at the greatest distance we have tried. I may give you an account of the first experiment that was made at a great distance. The transmitting instrument, similar in construction to the apparatus here shown, was placed on the top of the Franklin School-house, in Washington, and the selenium receiver inside a parabolic reflector—the identical receiver that we have here to-night—was placed in the window of my laboratory in L-street in the same city, the distance between the two being a little over 800 feet. It was impossible to communicate by word of mouth across that distance; and, while I was observing Mr. Tainter on the top of the school-house, almost blinded by the light that was coming in at the window of my laboratory, and vainly trying to understand the gestures he was making to me at that great distance, the thought occurred to me of listening to the telephone connected with the selenium receiver. Mr. Tainter saw me disappear from the window, and at once spoke to the transmitter. I heard distinctly what he said:—"Mr. Bell, if you hear what I say, come to the window and wave your hat." It is needless to say with what gusto I did wave my hat.

It is almost always the case that when we follow up one path of investigation, another opens upon our attention, and in the course of reducing to practice the idea of the photophone, as described to you to-night, Mr. Tainter and I have been led to a discovery of the greatest possible interest to the scientific world. Of course we all know that the molecular vibration, or disturbance in a rod of iron by the magnetising influence of an intermittent magnetic current can be heard as sound by placing the ear in direct contact with the rod of iron, and it occurred to us that a molecular disturbance of any kind, and however produced, if rendered intermittent, should in like manner be observed as sound by placing the ear in close contact with the substance. Now we know in the case of crystalline selenium that a molecular disturbance is produced by light. It is usually manifested to our senses through the medium of an electric current; but, if this theory were correct, this molecular disturbance should be developed as sound by placing the selenium in close contact with the ear, and rendering a beam of light intermittent. The form of apparatus for experiments on the question is on the table before me, and it may be well to show you on the screen the mode of using it. The light is rendered intermittent by being passed through one of the orifices in a perforated wheel, and as the actual apparatus is on the platform, it will not be necessary to enter into any detailed description of it. I shall briefly show you the arrangement of the whole in a sectional view. A beam of sunlight is brought to a focus by means of a lens. The diameter of the surfaces in the perforated disc, is just the diameter of the image of the sun formed in the focus of the lens, so that all the light impinging on this lens passes through the minute orifices of the wheel. The divergent beam is then again rendered parallel, so that it may be transmitted to the distant station, and is there converged on a piece of selenium in circuit with the telephone. You will understand that the rotation of this wheel will render the beam of light, falling upon the selenium, intermittent, and if the beam is interrupted a sufficient number of times per second, a musical note is perceived in the telephone. Now, our idea was that we should hear that musical note without the aid of the electric current or telephone, by placing the ear in close contact with the selenium itself. We made many experiments with different pieces of selenium, and even with other substances, to see whether this effect was produced, but the results were entirely negative. A very curious observation, however, was made in the course of the experiments. It was our custom to interrupt the musical tone by placing the hand in the path of the ray. The moment the shadow of the hand fell on the selenium, the sound immediately ceased, and the moment the hand was taken out of the path of the beam, the sound came again. In the course of our experiments, we were led to substitute, instead of the hand, a thin sheet of hard rubber, which happened to be in the workshop. At the end of the diagram, you will see the selenium receiver and the hard rubber—an apparently opaque sheet of hard rubber or ebonite—placed in the path of the beam. Now, the discovery to which I direct your attention first, is the fact that the interposition of this opaque substance does not entirely cut off the sound; that something passes through the hard rubber that affects the electric resistance of the selenium, and produces a sound. The effect is still more remarkable when, in place of holding the india-rubber near the selenium itself, it is held on the other side of the rotating disc, so that no light reaches the rotating disc. An invisible beam is brought to a focus, is rendered parallel by a second lens, and is again brought to a focus by another lens, and a musical note is developed at the telephone. I do not pretend to say what the nature of these rays is, but it is difficult to believe that they can be heat rays, for, in the first place, hard rubber is a substance which becomes heated when exposed to the sun's rays, and does not, therefore, transmit heat rays to any appreciable extent. But, if we place in the path of the beam, two sheets of hard rubber, and between them a glass vessel containing a saturated solution of alum, the effect is still obtained. I do not pretend to say what the cause of this strange effect may be. I have already told you of our attempt to hear molecular disturbance in selenium directly, without the aid of an electric current, but it occurred to us on observing the anomalous behaviour of the hard rubber sheet, to place it to our ears in place of the selenium that we had been experimenting with. The arrangement is shown on the next diagram.

placed the sheet of hard rubber in close contact ith my ear, while an intermittent beam of light as allowed to fall on the hard rubber, and clear distinct musical note was the result, e pitch of which depended on the rotation the wheel. That it was not in any way ie to any acoustical vibration in the air, was oved by simply interposing the hand in the path the beam. This would not have sufficed to revent the audibility of aerial vibration, but it at nce stopped the sound in the hard rubber. On ing a sheet of hard rubber as a diaphragm, and istening to it, as shown in the next illustration, he loudness of sound was very much intensified. t then occurred to Mr. Tainter and myself that it ight be necessary, in order to hear the molecular isturbance produced by light, that the substance ould be in the state of a thin diaphragm, so we made thin diaphragm of selenium, and the same effect as observed. A musical note was produced from the lenium directly, but the sound was not to be ompared to that produced by the hard rubber; was very much inferior in volume. But the urious fact comes out that all substances in the hape of a thin diaphragm emit sound when ex- osed to an intermittent beam of light. I have n the platform the various diaphragms with hich we have experimented; all the metals, even aper, mica, glass, carbon, and all sorts of sub- tances, in the shape of thin diaphragms, emit usical tones under the action of the inter- nittent beam. One other interesting feature s the difference in the intensity of the ounds produced by different substances, and his is a most interesting field of exploration or the scientific man. It occurred to us, as n explanation of the reason why it was necessary o use thin diaphragms for the different sub- tances, instead of masses, was, that the molecular listurbance produced by light was chiefly on the urface, and the vibration had, therefore, to be transmitted through the mass of the substance in order to produce the effect. We thought, therefore, that if we could listen at the illuminated side of the diaphragm, we should hear the sound with greater distinctness. It is rather difficult to arrange apparatus suitable for this experiment; but the following form occurred to us. Instead of using a substance in the shape of a thin dia- phragm, we used it in the shape of a tube. We first of all experimented with an ordinary rubber ube. The light was brought to a focus just at he mouth of the tube, so that the beam diverging from the focal point, struck the interior sides of the ube. We listened at the other end of the tube, and, of course, our ears were then in communica- tion with the illuminated side. A distinct musical tone was heard, and every substance we have tried, in the shape of a tube, has emitted musical tones in this way. We can even hear sound when, in place of an artificial tube, we focussed the light into the interior of the ear itself.

Another form of this experiment has occurred to me since my arrival in Europe; and the sun, very fortunately, coming out for a few hours, while I was in Paris, I was enabled to put it into execu- tion with success. If we take a transparent vessel, such as a test-tube, we can place in- side it substances in any physical condition— n the solid liquid or gaseous state—and by con- necting the open mouth of the test-tube with a hearing-tube, we can listen while we throw an intermittent beam of light on the substance through the transparent glass of the test-tube. All the substances that I was able to try in the short time at my disposal yielded musical notes, with the exception of water and chlorate of potash in the state of powder. Crystallised sulphate of copper gave a very beautiful note. A whole cigar placed in the test-tube also emitted quite a loud note; but the best sound I think was produced by some little chips of pine wood dropped into the tube. It is not necessary that the substances should be solid or liquid; it is sufficient to fill the test-tube with tobacco smoke, and the musical note is produced, whereas without the tobacco smoke no sound, or a very slight sound, is developed. I have been able to repeat these experiments, within the last few days, at the Royal Institution, with the aid of your artificial sun (for we cannot hope to have the natural sun in London in November or December), the electric light. Professor Tyndall suggested a modification of the experiment that has also proved successful—to fill this tube with an absorbent gas. We placed a few drops of sulphuric ether at the bottom of the test-tube, and then submitted the perfectly transparent test-tube to the action of the intermittent beam of light. A distinctly audible, but feeble, musical tone was the result, and this is very suggestive and very significant, as it seems to prove that the action is strictly a molecular action, and that we can hear even in a gas the result of a molecular vibration. I have taken up a great deal of time, and I must thank you very much for the way in which you have listened to me to-night. I only wish that I could show you instruments in operation, but the effects produced, though perfectly demonstrable, are too feeble to be satisfactory to an audience like this. We require great quietness and a good light. If we only had the sunlight here, I should have no hesitation in making the experiments, but as it is, we are obliged to confine our experiments to a few scientific men, working at such a labora- tory as that of the Royal Institution.

DISCUSSION.

The Chairman having invited Dr. Siemens to explain his "Selenium Eye,"

Dr. Siemens, F.R.S., said he had listened with intense interest to the discourse which Professor Graham Bell had given. The world had been astonished before with his invention of the telephone, and now he came forward with an instrument equally marvellous in its results. The property of selenium to alter its electrical resistance under the influence of light, was, as had been stated first brought before the world by Mr. Willoughby Smith, and so remarkable was this discovery that many phy- sicists turned their attention to the subject. His brother, Dr. Werner Siemens, took up the inquiry with a view of determining the cause of this extraordinary varia- tion in resistance caused by light, and the conclusion to which his researches, which were communicated to the Berlin Academy, led him, was that the resistance of selenium, and probably, indeed, of all substances, varied inversely to the amount of heat which they contained; and the reason why selenium showed such extraordinary changes under the influence of light was, that under that influence, it changed from one aggregate condition to another—from an amorphous to a crystal-

line condition; and that at the moment when this change took place, a great deal of heat was absorbed, and therefore the specific heat of the selenium was very much increased. This was strictly a molecular change, and bore on the further discovery which Professor Graham Bell had made, that he could hear the changes going on even in gaseous bodies, produced by the passage of light. The little instrument which he (Dr. Siemens) had constructed to show the members of the Royal Institution was on the table. It had the form of an eye, and on opening the lids, a lens was presented to the light; through that lens, the light, falling upon it, was concentrated upon a spot in the interior of the ball. At that spot one of the selenium gratings, which had been described, was placed, a grating not larger than a threepenny piece, consisting of five wires laid in zigzag fashion; one wire was connected to the positive, and the other to the negative pole of a battery. These wires, lying close together, but not touching, were laid on a plate of mica; a drop of selenium was placed upon them, and this small quantity sufficed to produce the desired results. The principal object he had in devising it was to construct a selenium photometer; but a difficulty arose in using it for that purpose, because selenium got fatigued under the influence of light. The eye, after being exposed for any considerable period to an intense light, became insensitive, and the lids had to be closed; it had to go to sleep for some time before it regained its sensitiveness, and the analogy to the human eye went even further than that. If the eye were used after having been kept in the dark for a length of time, it would detect the slightest gleam of light, and mark it on the galvanometer, whereas after it had been once used in intenser lights, a small gleam would be utterly lost upon it, until it had again had ample rest. The instrument before them had not been used for some years, and it might still be active, but the audience would have to take the Chairman's word for it, since the galvanometer in circuit with the "eye" was not one whose indications were visible to a number of persons at once. [Dr. Siemens then experimented with variously-coloured sheets of cardboard prepared for the purpose, and the reflected light was found to cause a deflection of the galvanometer in each case, the slightest effect being produced with light reflected from a black piece of paper, and successively increasing with green, red, and white, the greatest of all being produced by exposing it to the direct light of an argand burner.] These experiments showed the great sensitiveness of selenium; but Professor Bell had gone much further, and had prepared an instrument with concentric plates of selenium and intervening plates of mica, and operating upon a much larger surface. He had gone much further than had been done previously. Then came the further step which he had so boldly taken, of making light become the carrier of speech. As he had justly said, this seemed marvellous at first, but when you knew how to do it, it became simple, like everything else, and he (Dr. Siemens) must congratulate the Society on having had the method of doing it so clearly explained.

Mr. W. H. Preece referred to the high honour which Professor Graham Bell had done him in asking him to bring before the English public his great invention of the photophone, and said he had willingly undertaken the task, but had had to give it up in consequence of another event with which Professor Bell was indirectly connected. It was an immense relief to him to find that just as he had written to the secretary to say that he could not read a paper, Professor Bell himself telegraphed to say that he was coming, and the consequence was they had had one of the pleasantest evenings he had ever spent in that room. It was not only the beauty of the discoveries, and the clear manner in which they had been described, which he admired, but the truly scientific way in which they were followed up, and the way in which the matter had grown in the hands of Professor Bell and Mr. Tainter, until it burst out like a flower in full bloom. And there was another interesting point in connection with this instrument, and that was that, following the excellent example of Professor Hughes, Mr. Bell had thrown this investigation open to the public, unrestricted by any patent. They had heard a great deal, at different times, of the efforts poets made to try and extract ideas from nature; one had talked about bringing down lightnings from heaven, another spoke of bringing "spirits from the vasty deep," and another spoke of "the music of the spheres;" but, to-night they had seen how a patient, plodding philosopher could go to the other extreme, and make those little molecules which the eye could not see, and the mind scarcely grasp, imitate the beautiful modulations of the human voice. Professor Bell had caused a great deal of trouble to practical men, especially to telegraph engineers, by forcing them to deviate, to some extent, from their own sphere, and study the science of sound, but now he had compelled them also to go into the study of light; but they were indebted to him, not only because he had added to their practical apparatus a useful appliance, but because of the interesting and singularly beautiful nature of his discoveries.

Professor Hughes, F.R.S., being next called upon by the Chairman, merely expressed his admiration of the apparatus.

The Chairman said it only remained for him to discharge a work of supererogation by proposing a vote of thanks to the lecturer. They had had the matter put before them by Mr. Preece, in language more worthy of a poet than of a chief telegraph engineer, and in a way they would always remember. He could not pretend to emulate that style, nor to speak adequately on the subject of the evening, but the audience might consider for a moment what they had had brought before them—the intimate connection of those things which used to be considered three separate subjects of study, and three distinct sciences—electricity, light, and acoustics. Professor Bell had shown them that the three had so intimate a connection that it was perfectly possible, where there was adequate light, and the means of transmitting it from place to place, not indeed to make that light the conveyor of sound, but to make it reproduce, at a distance, the sound which in the outset caused the light to vary in its intensity. It was a matter which, if the present generation were capable of surprise at any scientific discovery, would certainly surprise them. Would not the proposition have been said to emanate only from one worthy of a distinguished position in a lunatic asylum—the proposition, "I desire to convey sound to a distance: I have no means of doing it excepting by a ray of light." It would have been said at once, "You cannot do it; that is not a means; it is incredible and impossible;" and it might have been so said even after Professor Bell's wonderful discovery of the telephone. When they first heard of that, it struck them as one of those wild suggestions which occasionally were made, and came to nothing. Only about a year ago they saw in the public prints that some person in Australia had discovered a means of sending human beings and animals to sleep for any length of time required, and they were told they were to get fresh meat from Australia, by sending animals over in a somnolent state, to be woke up to be killed. They all laughed at that, because it did not turn out to be true; but it might have been true, and if it had been, it did not seem to him so wonderful as the statement:—"I wish to repeat a sound that has been heard in London, in a village 10 miles off. I have no means of doing it, except the sun's rays, and I will do it with that." Nobody making that statement would have been entitled to belief, but yet Professor Bell had brought it into the range of an accomplished fact. Unhappily, it was one of those delicate experiments which could

only be shown before a chosen few, and in places well adapted for the purpose. The great advantage of having a subject of this kind taken up by a man of Professor Bell's calibre of intellect, was this—that as he went on experimenting, new circumstances arose, and he had brought forward that evening such a list of suggestions for extended inquiry in physics, as would occupy the scientific men of Europe for many years to come. In conclusion, he (the Chairman) hoped that, as many had been unable to attend the lecture that evening, Prof. Bell, if he could not repeat the lecture, as he did that on the telephone on a former occasion, would obtain a promise from Mr. Preece to do it for him.

The vote of thanks having been passed unanimously,

Professor Graham Bell, in thanking the meeting, said he wished it were in his power to accede personally to the Chairman's request, but engagements on the other side of the Atlantic would make this his last lecture on this subject in Europe. He would, however, do his best, with great pleasure, to prevail on Mr. Preece to fulfil the request which had been made.

"DESCHUGARA," A NEW CEREAL AND FORAGE PLANT.

A new forage plant is announced from Central Asia, under the name of "Deschugara." It is said to be largely cultivated in Turkestan, as well as in Poland, where it has given most satisfactory results. From 100 lbs. of seeds sown, 2,800 lbs. of grain have been harvested, and a large quantity of straw, which is consumed with avidity by cattle and sheep. The plant has a tall-growing, stout stem, which forms a green cattle food. A variety of the plant ripens three months after being sown. In the climate of Odessa it is described as arriving at maturity as soon as it does in its own country. The chemical composition of the plant approaches very nearly to that of the oat and barley, so that it is extremely useful as a cattle food. The seeds, however, reduced to powder, are used as ordinary flour. Some mystery attended the botanical identification of this plant, when its properties were first made known in the pages of a continental journal some few weeks since. Mr. Christy has, however, succeeded in obtaining some seed from Russia which, together with information he has also obtained, prove the plant to be that of *Sorghum cernuum*, a grass closely allied to the well-known Dhurra of India.

CORRESPONDENCE.

PEPPERMINT TEST FOR DRAINS.

It seems to me that the Boston plan of using oil of peppermint (described in the *Journal* of November 19), is rather clumsy, inasmuch as the small quantity of oil used might stick in some crevice and not be washed out by the two pails full of water, by which it is followed. I prefer to shake up the oil thoroughly with water in the largest available bottle, before pouring it down. It does not dissolve in the water, nor does it really mix with it, but it forms a strong-smelling emulsion, which answers the purpose just as well as a true solution in alcohol would. It would be interesting to know what quantity of the oil the small bottles contain, which are to be bought in Boston at two dollars the dozen, or about eightpence each, and whether the quality is at all equal to English Mitcham oil. Our practice at present is to use an ounce of the Mitcham *oil for each house* that we test, and that costs 2s. 6d. We have tried the foreign oil, which can be bought at about half the price, but we find that it is only half as strong, or in other words makes only half the quantity of emulsion, so that there is no economy in using it. What we want is that some manufacturer would make an oil as strong smelling as the Mitcham oil, but not so highly refined, and which could be sold cheaper. As the demand increases we have no doubt that this will be done. Our experience is the same as that of the Boston people as to the necessity for the person who pours the oil down not mixing among those who are trying to detect any escape of it from drains or pipes, as he brings an amount of the vapour adhering to his clothes, which makes accurate observation of leaks impossible.

Ether, which we formerly used, was not so bad in that respect, but it was too expensive, and also rather dangerous, so we always use oil of peppermint now.

COSMO INNES.

7, John-street, Adelphi.

"HAYDON'S PICTURES TO THE COAL-HOLE!"

Although such were the words recited to me by Sir Martin Archer Shee, it is but justice to Haydon to say that he denied them. It so happens that I am, by chance, reminded of this. In 1842, I reviewed Haydon's lectures on "Fresco," in the "Civil Engineer and Architects' Journal" for 1842, vol. v., and introduced the coal-hole anecdote. At p. 201 is a characteristic letter by Haydon in reply to the review, and denying the anecdote. At p. 388 is another curious contribution on Wilkie, and at p. 413, one on schools of design by Haydon.

HYDE CLARKE.

32, St. George's-square, S.W., 29th November, 1880.

OBITUARY.

G. W. Yapp.—By the death of Mr. G. W. Yapp, on the 15th November, at the age of 69, the Society loses a frequent correspondent to the *Journal*. Mr. Yapp, born in London, was the son of a naval officer belonging to an old Herefordshire family. He was connected by family ties, among others, with Sir Walter Scott, Dickens, and Douglas Jerrold. In early life he was trained in the secretariat of Joseph Hume, but he entered too late to benefit materially by that economist's patronage. He commenced his literary work in 1837, as a writer for the "Penny Cyclopœdia." He proposed a plan for the formation of the Parliamentary library at the Reform Club, and assisted materially in carrying it into execution. In 1851, Mr. Yapp compiled the catalogue of the Great Exhibition of 1851. He was for a long time an agent in London and Paris for a patent firm at Washington. His exhibition connexion took him to Paris, where he was in 1855, and he there compiled "Duties on Imports into France." He had collected the materials for a technological dictionary, French and English, which was never published. In 1858 and 1859 he was Paris correspondent of the *Daily Telegraph*. He prepared the English translation of the Official Catalogue in 1867, and which was presented to the Emperor some hours before the French edition. He unfortunately staid in Paris during the siege, and suffered its terrible vicissitudes, losing there one of his children, and laying the foundation of mortal illness for himself and another child. His account of the siege appears in the "History of the Franco-German War" *Mackenzie*, Glasgow).

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock. For meetings previous to Christmas:—

DECEMBER 8.—"London Fogs." By Dr. ALFRED CARPENTER. EDWIN CHADWICK, C.B., Vice-President of the Society, will preside.

DECEMBER 15.—"The Use of Sound for Signals." By E. PRICE EDWARDS, Secretary to the Deputy-Master of the Trinity-house. Dr. TYNDALL, F.R.S., will preside.

For Meetings after Christmas:—

"Buying and Selling; its Nature and its Tools." By Prof. BONAMY PRICE. On this evening Lord ALFRED S. CHURCHILL will preside.

"Causes of Success and Failure in Modern Gold Mining." By A. G. LOCK.

"The Participation of Labour in the Profits of Enterprise." By SEDLEY TAYLOR, M.A., late Fellow of Trinity College, Cambridge.

"The Gold Fields of India." By HYDE CLARKE.

"Flashing Signals for Lighthouses," By Sir WM. THOMSON, F.R.S.

"The Present Condition of the Art of Wood-carving in England." By J. HUNGERFORD POLLEN.

"Five Years' Experience of the Working of the Trade Marks' Registration Acts." By EDMUND JOHNSON.

"Trade Prospects." By STEPHEN BOURNE.

"The Manufacture of Aërated Waters." By T. P. BRUCE WARREN.

"The Compound Air Engine." By Col. F. BEAUMONT, R.E.

"Improvements in the Treatment of Esparto for the Manufacture of Paper." By WILLIAM ARNOT, F.C.S.

"Deep Sea Investigation, and the Apparatus used in it." By J. G. BUCHANAN, F.R.S.E., F.C.S.

"The Discrimination and Artistic Use of Precious Stones." By Prof. A. H. CHURCH, F.C.S.

"Forest Conservancy in India." By Sir RICHARD TEMPLE, Bart., K.C.S.I.

"The Tenure and Cultivation of Land in India." By Sir GEORGE CAMPBELL, K.C.S.I., M.P.

"Indian Agriculture." By W. R. ROBERTSON.

"Trade Relations between Great Britain and her Dependencies." By WM. WESTGARTH.

"The Languages of South Africa." By R. CUST.

"The Loo Choo Islands." By Consul JOHN A. GUBBINS.

CANTOR LECTURES.

Monday Evenings, at eight o'clock. The First Course, on "Some Points of Contact between the Scientific and Artistic Aspects of Pottery and Porcelain." Five Lectures, by Prof. A. H. CHURCH, M.A. Oxon., F.C.S.

LECTURE III.—DECEMBER 6.

Stoneware and other wares glazed with salt.

LECTURE IV.—DECEMBER 13.

Soft paste porcelains, European and Oriental.

LECTURE V.—DECEMBER 20.

Hard paste porcelains, Chinese, Japanese, and European.

The Second Course will be on "Watchmaking," by EDWARD RIGG, M.A. Three Lectures.

The Third Course will be on "The Scientific Principles involved in Electric Lighting," by Prof. W. G. ADAMS, F.R.S. Four Lectures.

The Fourth Course will be on "The Art of Lace-making," by ALAN S. COLE. Three Lectures.

The Fifth Course will be on "Colour Blindness and its Influence upon Various Industries," by R. BRUDENELL CARTER, F.R.C.S. Three Lectures.

ADMISSION TO MEETINGS.

Members have the right of attending all the Society's meetings and lectures. Every Member can admit *two* friends to the Ordinary and Sectional Meetings, and *one* friend to the Cantor Lectures. Books of tickets for the purpose have been issued to the Members, but admission can also be obtained on the personal introduction of a Member.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, DEC. 6TH ... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Prof. A. H. Church, "Some Points of Contact between the Scientific and Artistic Aspects of Pottery and Porcelain." (Lecture III.)

Farmers' Club, Inns of Court Hotel, Holborn, W.C., 4 p.m. Annual General Meeting. Mr. Clare Sewell Read, "America and its Farming."

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Society of Engineers, 6, Westminster-chambers, 7½ p.m. Mr. Frank W. Grierson, "The National Value of Cheap Patents."

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 7, Adelphi-terrace, W.C., 8 p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. Leslie Stephen, "The Relation of Morality to Literature."

TUESDAY, DEC. 7TH...Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. Theophilus Seyrig, "The Different Modes of Erecting Iron Bridges."

British Horological Institute, Northampton-square, E.C., 8 p.m. Mr. Edward Rigg, "Friction."

Pathological, 53, Berners-street, Oxford-street, W., 8½ p.m.

Biblical Archæology, 9, Conduit-street, W., 8½ p.m.

WEDNESDAY, DEC. 8TH...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Dr. Alfred Carpenter, "London Fogs."

Geological, Burlington-house, W., 8 p.m.

Microscopical, King's College, W.C., 8 p.m. 1. Dr. Hudson, "*Floscularia trifolium* n. sp." 2. Mr. C. Stewart, "Some Structural Features of *Echinometridæ*." 3. "Notes on the Movements of Diatoms, the Construction of Object Glasses, Swinging Substages, &c."

Royal Literary Fund, 10, John-street, Adelphi, W.C., 3 p.m.

Telegraph Engineers, 25, Great George-street, S.W., 8 p.m Mr. W. H. Preece, "The Photophone and the Conversion of Radiant Energy into Sound."

THURSDAY, DEC. 9TH...Royal, Burlington-house, W., 4½ p.m. 1. Major Herschel, "A Simplified Form of the Torsion Gravimeters of Broun and Babinet." 2. C. Schröter, "Note on the Microscopic Examination of some Fossil Wood from the Mackenzie River." 3. Dr. Hopkinson, "Electrostatic Capacity of Glass." II. 4. Dr. Urban Pritchard, "The Cochlea of the *Ornithorhyncus platypus* compared with that of Ordinary Mammals and of Birds."

Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 7 p.m. Dr. Lionel S. Beale, "The Germination and Propogation of Disease."

Inventors' Institute, 4, St. Martin's place, W.C., 8 p.m.

Royal Society Club, Willis's-rooms, St. James's, S.W., 6 p.m.

Mathematical, 22, Albemarle-street, W., 8 p.m. 1. Prof. Teixeria, "Note sur Dérivation des Déterminants." 2. Mr. W. B. Grove, "The Solution of the Inverse Logical Problem." 3. Mr. T. Craig, "Motion of a Viscous Fluid."

FRIDAY, DEC. 10TH...Froebel Society (at the HOUSE OF THE SOCIETY OF ARTS), 6 p.m. Annual Meeting.

Folk Lore Society, 22, Albemarle-street, W., 8 p.m. Mr. John Fenton, "The Birth of a Deity; or the Story of Unkulunka."

Astronomical, Burlington-house, W., 8 p.m.

Quekett Microscopical Club, University College, W.C., 8 p.m.

Clinical, 53, Berners-street, W., 8½ p.m.

SATURDAY, DEC. 11TH...Physical, Science Schools, South Kensington, S.W., 3 p.m. 1. Lieut. L. Darwin, "The Rate of Loss of Light from Phosphorescent Surfaces." 2. Dr. Alder Wright, "The Determination of Chemical Affinity in Terms of Electromotive Force."

Royal Botanic, Inner-circle, Regent's-park, N.W., 3¾ p.m.

L OF THE SOCIETY OF ARTS.

No. 1,464. VOL. XXIX.

DAY, DECEMBER 10, 1880.

tions for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

FORM OF THE PATENT LAWS.

ncil adopted the following Petition to of Commons, at their meeting on Mon- ist.:—

IGHT HONOURABLE THE COMMONS IN PARLIAMENT ASSEMBLED.

ble Petition of the Council of the Society anufactures, and Commerce, incorporated harter,

H,—

the Society is deeply interested in the r, and submits that it ought to be made , as far as possible, to the progress of Manufactures, and Commerce of this o as to allow the inventions of the gdom to compete fairly with those of ld.

the Society, in the years 1850, 1851, and ished reports on the Patent-law as then nd that those reports were instrumental g Parliament and the Government to atent-law Amendment Act, 1852, which reformed the law.

the effect of such reform has been greatly te invention, and has so increased ts derived from Patent fees, that they eached the sum of £180,000 a-year, of about £40,000 are expended in con- h the administration of the law, leaving s a tax on the progress of invention.

your petitioners are of opinion that the etains some antiquated fictions which abolished; that it should be greatly and that, as Patents relate to Arts, res, and Commerce, all matters connected should be administered by persons owledge of Arts, Manufactures, and and not by legal functionaries, how- nt.

your petitioners desire to call the atten- ur Honourable House to the Patent which is in an unsafe, overcrowded, lthough it contains unique and valuable of those early mechanical inventions revolutionised the Arts, Manufactures, erce of the civilised world; that such quite unworthy of the Nation, and e replaced by a suitable building, con- ommodation for a Reference Library.

itioners, therefore, pray your Honour- to cause the present Patent-law to be amended, and its administration to be entrusted to the Lords of the Privy Council for Trade.

And your petitioners will ever pray.

Signed on behalf of the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce,
H. TRUEMAN WOOD, *Secretary.*

The Council also appointed a Committee to draft a Bill for submission to the Government.

JUVENILE LECTURES.

The usual short course of lectures, adapted for a juvenile audience, will be given by Mr. G. J. Romanes, F.R.S., on "Animal Intelligence."

The dates for the lectures will be Wednesday, 29th December, and Wednesday, 5th January.

The lectures will commence at seven o'clock. As in former years, admission will be by ticket only. A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received, and the issue will then be discontinued. Subject to these conditions, each member is entitled to a ticket admitting two children and one adult. All members who require tickets should apply at once, as there may be difficulty in accommodating those who postpone their applications until the date fixed for the lecture.

By order,
H. TRUEMAN WOOD, *Secretary.*

PRACTICAL EXAMINATIONS IN VOCAL AND INSTRUMENTAL MUSIC.

The next Examination in London will be held at the Society's House during the week commencing 10th of January, 1881.

The Examination will be held at three periods —morning, afternoon, and evening—viz., from 10 to 1, 2 to 5, and 7 to 10 o'clock on each day of Examination. Candidates may select either of these periods, but, the number of candidates in these Examinations being large, no special day or hour can be arranged for. The numbers will therefore be arranged in order of application. The Examination for the Organ and Harmonium will be held in the evening only, and special arrangements will be made according to the number of applications.

The fee is 10s. for the Honours (including both vocal and instrumental Examination), and 5s. for the First or Second Class (vocal or instrumental) Examination. If vocal as well as instrumental music, or two separate instruments, be taken by the same candidate for the First or Second Class Certificate, a fee of 7s. 6d. must be paid.

The Certificates will be prepared as soon as

possible after the Examinations, and can be had upon application at the House of the Society of Arts, on or after 1st March, 1881.

No Certificate will be granted to any candidate for Honours who does not obtain a First Class in the practical portion of the Examination, either vocal or instrumental. Candidates holding one of such Certificates, obtained in a former year, need not again undergo this portion of the Examination, but should bring their Certificate for the Examiner's inspection.

The Examination of each candidate will be private; no one but the Examiner and the accompanyist being present, unless it be a member of the Society of Arts' Committee. No list of candidates will be published.

Particulars will be forwarded on application to the Secretary, Society of Arts, John-street, Adelphi. No names can be received after 24th Dec. 1880.

PROCEEDINGS OF THE SOCIETY.

FOURTH ORDINARY MEETING.

Wednesday, December 8th, 1880; EDWIN CHADWICK, C.B., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Aird, David Alfred, 2, Sussex-gardens, Hyde-park, W.
Angus, Joseph, The Hermitage, Langly-lane, South Lambeth, S.W.
Biddiford, George Francis, Barnwood-lodge, Gloucester.
Clements, Hugh, 5, Park-terrace, Peckham, S.E.
Foster, Thomas Nelson, Allt Dinas, Bays-hill, Cheltenham.
Morton, Joseph, 39, Cheapside, E.C.
Obach, Dr. E., 17, Charlton-villas, Church-lane, Old Charlton, S.E.
Ridpath, J. Lionel, 12, West Kensington-gardens, W.
Snelgrove, Horatio Richard, The Grove, Clapham-common, S.W.
Sykes, Fred. W., Gosport Mills, Huddersfield.
Traill, James Christie (of Rattar, N.B.), Castle-hill, Thurso, Caithness.
Vogel, Sir Julius, K.C.M.G., 135, Cromwell-road, South Kensington, S.W.
Ward, Frederick Peterson, 46, Hamilton-terrace, St. John's-wood, N.W.
Wright, John Brooks, 96, Buchanan-street, Glasgow.
Young, Charles E., 71, Clapham-road, S.W.
Young, Sir Charles Lawrence, Bart., 5, Ashburn-place, Cromwell-road, S.W.
Young, George, 7, The Terrace, Ryde, Isle of Wight, and 43, Dover-street, Piccadilly, W.

The following candidates were balloted for, and duly elected members of the Society:—

Brenchley, Samuel, Hunt Bridge-house, Matlock.
Gassiot, Charles, Elmwood-house, Upper Tooting.
Gundry, Joseph Pearkes, the Cottage, Bridport, Dorsetshire.
Jaques, Leonard, J.P., 18, Seymour-street, W.
Laxton, Frederick, Brighouse, Yorkshire.
Nix, John H., 77, Lombard-street, E.C.
Noel, Hon. Henry, 17, Westbourne-terrace, W.
Northampton, Marquis of, Castle Ashby, Northa
Ormerod, Thomas, Woodfield, Brighouse, Yorks
Robertson. Sir D. Brooke, C.B., Athenæum Club
Robertson, J. Murray, Lower Grove-house, hampton.
Seymour, Major-General W. H., Travellers' Pall-mall, S.W.
Sheppard, Samuel Gurney, 31, Oxford-square,
Simmons, Charles J., 56, Leverton-street, Lei road, N.W.
Skaife, John Slade, 32, Milner-square, N.
Slade, Francis William, Eldon-pk., South Norwoo
Volk, Magnus, 40, Preston-road, Brighton.

The paper read was on—

LONDON FOGS.

By Alfred Carpenter, M.D.

There are fogs and fogs. I am not about you to consider all kinds of those creations. is the fog which pervades men's brains, and from them the power of judging rightl separating truth from error. There is a fog may be aptly called error, ever seeming to p itself for the purpose of blurring the outline vision, of interfering with our power of pu a right path, and causing us to follow a one. This kind of fog, though fully in my is not the fog with which we have to deal to- except it may be as a link connecting our s with the difficulties which beset its conside I do not propose to ask you to inquire i causes of the regular Scotch mist, which we through and through almost before you real fact that it is a fog, neither do I propose to upon the causes of those fogs which ris the bosom of the great deep, and are occasi carried by the wind into all parts of our These are not the fogs I ask you to consider. are white fogs, seldom, if ever, producing darkness, except during the dark hours selves; they do not shut out all evide the ruler of the day whilst he is above the h as if he were not. They do not cause the of the air to return to their roosts und impression that Nature has changed her Neither is it with those mists which rise the bosom of Father Thames, or of any stream running, either above or under g These fogs will present themselves wh there is a particular kind of change i meteorological condition of the atmos and when heat, moisture, and pressur rapidly altered in the necessary direction. fogs are all beyond the power of man to increase or decrease, to control or prevent. are natural events, which will happen in s man or of his works, and nothing that he will materially alter their incidence. At time exist everywhere in the lowlands of the Islands; they must be endured, but their evil may be, in a great measure, warded off by means based upon common sense. But are other fogs which are not primeval, wh not exist everywhere, and which are produc the acts of man himself, and are caused by ful works which need not continue in ope

hey are specially peculiar to great aggregations ' people, and their densest points are always to .e leeward of the masses which have produced .em. Their worst effects date from the introduc- ɔn of coal, which gave power into the hands of en to defy distance, and to bring millions, or a oiety of the million, into the close intercourse a great city; but they are not to be found . all great cities, for aggregations of peoples, ıch as at St. Petersburg and Moscow, who o not burn coal in the wasteful way that we ıo, are not visited with them; neither are hey found in the great cities of the East, which, rom the natural warmth of their surroundings, do ıot want fires in a general way. I am not about o assert that the fogs I speak of are entirely aused at all times by fuel smoke. I am not about) assert that coal smoke is alone responsible for l the evils which belong to these fogs, but it is the rincipal factor which make London and its suburbs itolerable as places of residence for certain nstitutions. It does materially add to the ıortality of the metropolis, and at times it is ıe sole cause of conditions which prevent the roper enjoyment of that life which kind Provi- ence intended for us. It is a main factor in the roduction of a high rate of mortality, arising om the absence of ozone, or of ozonised oxygen, r depreciation of oxygen capable of immediately :ting upon changing organic matter. It also auses many of ou public buildings to show signs f premature decay, and, day by day, is producing destruction of property which, if it could be opped, and its value accurately estimated, ould probably be sufficient to repay ten times ver the cost of the works which are required) prevent this unnecessary and ruinous loss. : will be asked, how I am able to prove ıe truth of my proposition. That is the usiness now before us. I think it has been fully roved of late years, by the numerous fogs which ave occurred in the midst of summer, shutting ut the light of day, and producing an Egyptian darkness at times when ordinary fogs have not existed. It was fully proved by a fog which occupied the West-end of London the other day, and which caused a mid-day darkness on a Sep- ember Sunday, which could be felt. That day ad not been preceded by any cold weather, the arometer was high, and was rising; the thermo- neter was high, it was not falling, and the dew oint was high. The air was still, there was no erceptible wind; there was, however, an exceed- ngly slight current, which, as I afterwards found, ccupied within a narrow space nearly all the oints of the compass. The centre of a circle hus produced was mainly at the West-end of London. Some magnetical changes, the nature f which was not apparent, led to the production f a dense atmosphere at 11.30 a.m., on September 6th, which indirectly caused gas-lights to appear n Buckingham Palace and other parts of Bel- gravia, obscured the sun at mid-day in as perfect a anner as it was possible to be obscured over a great town by human aid. I say advisedly, by uman aid, because a few experiments made upon he spot proved that the darkness was caused by nconsumed carbon in the atmosphere: that he pall thus spread over the place was imited to a moderate elevation, not reaching much above the tops of the houses, so that the tallest of them could in places be just seen peering above the dark cloud which rested upon the earth. When one was able to get out- side the veil which hung upon the metropolis, its cause could be seen pouring down from every chimney which was acting as an upcast for a fire. The sun was quite invisible from the surface of the ground, but appeared as a copper-coloured disc from the upper windows in the houses in the Oxford-street side of Hyde-park. The sky was compara- tively cloudless, but there was no warmth in the sun's beams over London, no comfort in his aspect, and not a shadow of heat could be col- lected by a pocket lens, although outside the pall the sun was shining brilliantly, and the country enjoying a perfect summer's day. The air was warm outside, temperatue 64°. The grass in Hyde-park was perfectly dry, as shown when the hand was passed over it. The particles of black matter, which were collected on a similar occasion, on a micro- scopical glass slide moistened with glycerine, shewed the same appearances in the field of the microscope as that exhibited by a similar slide designedly exposed to the smoke of a common chimney, viz., particles of unconsumed carbon and some oily matter, which was of a tarry nature. There was also the other accompaniments of smoke in the air,—viz., an acid gas, which acted upon moistened litmus paper, and which, by the irritating effect which it had upon the bronchial mucous membrane, was something more than car- bonic acid. Other tests showed that this was sulphurous acid, which existed so abundantly as to counteract the naturally soothing effect of the car- bonic acid, which was also largely in excess. I have sometimes found ammonia, but on this occasion it was neutralised, if present, by the acid, and yet left sufficient of free acid to decidedly affect the bronchial mucous membrane. The air was not tested for ozone, but that none existed was very manifest. The openings from the public sewers gave unmistakeable evidence of a greater warmth below, which, telling upon the contents of the sewers themselves, produced a fermentation, obvious as to its origin; but, curiously enough, the smell was not perceived a few yards away from the gratings. I may be allowed to mention, in pass- ing, that the presence of carbon and sulphurous acid in the atmosphere appeared to be of great use, altering the character of the emanations from the public sewers, and giving the inhabitants of this great city a present protection from the effects of one of the greatest engineering errors of the present time—one of those great mistakes which engineers are constantly making uuder the name of sanitary work, whilst they are breaking a fundamental or canon law of sanitary science. I may, perhaps, be allowed to give the ground of that law. Any sewer which be- comes a sewer of deposit, either by accident or design, has been constructed in defiance of sanitary law, and must in due course bring insanitary re- sults to those exposed to its influence: it is wrongly constructed, and is a mistake. I mention this point now, to show that the smoke of a great town is not an unmitigated evil, but that it has a mission, so to speak, which is not yet completed. It is a truism, nevertheless, that two wrongs cannot make a right. The right to pure air

ought not to be sacrificed to the necessity for impurity, because other works have failed to effect the object for which those works should have been constructed.

I must, however, now give further proofs that smoke is the cause of the darkness which these fogs produce. Fogs of all kinds are limited in the extent to which they reach upwards. Natural fogs do not reach an altitude sufficient to shut out daylight, for as soon as their ordinary depth reaches a certain extent, the fog lifts and floats away, or the meteorological changes are such as lead to its dispersion. So also with smoke fogs; they do not reach any altitude, and very often scarcely rise above the chimneys which pour them out, yet they often produce complete darkness. This is never seen in day-time, as the result of a wet fog, when there cannot be a suspicion of fuel-smoke. Has a darkness ever been produced at mid-day on the Scotch moors or among the Irish bogs? Has it ever been seen on the great ocean between this and the Western Continent? Fogs there are, intense and deep; shutting out sight as far as distance is concerned, it may be even limiting vision to a few feet; but there is always a whiteness about it, quite different from the fog of a great town. A pocket lens will easily show that this whiteness is due to minute particles of water, capable themselves of transmitting light, but which transmission, whilst decomposing an individual ray, yet re-combines the elements into white light again, and when the particles are filtered out by means of pure cotton wool, are shown to be composed of water. Not so a large part of the particles which are found in the fogs of great towns; they consist, in great measure, of organic matter, capable of absorbing light, not transmitting it, and, when filtered out of air by means of cotton-wool, are black-looking matter, with oily particles of some hydrocarbon oil of a tarry consistence, which seems to envelope the atom of water which is with it. Sometimes the oily matter is in excess; sometimes it is the solid carbon which is more abundant. By long continued exposure of plates of moistened glass, some crystals of sulphate of ammonia may be obtained, and also occasionally other kinds of *débris*, but, on the whole, the sooty particles are largely in excess of everything else.

The other day I went down to Reading, by the Great Western Railway. At Croydon the air was clear, the sky bright, but it was cold. London itself was dull and somewhat foggy. After leaving Paddington, a dark bank of cloud, resting upon the earth and reaching to an elevation of some hundred feet, limited vision to within a few yards of the line on its left-hand, whilst on the right the view was uninterrupted as far as the landscape allowed. The bank followed a straight line; it did not follow the turns and windings of the river, as would have been the case if it had been due to water as a main cause. The wind during the morning had been quietly veering from north to east, and with it came the line of smoke as clearly marked as any cloud could be. That it was not due to Father Thames was clearly seen when, on another occasion, the wind changing to north, a similar dense cloud came with the change of wind, and hung over the Sydenham hills and the heights about Sutton and Banstead, whilst the valley of the Thames above London was comparatively clear. I have often watched these changes of wind from different parts of the Surrey hills, and seen the Crystal Palace disappear from view, although, at the place at which I was stationed, the sun was shining brightly, and shortly before the eclipse of the palace took place, the sun's rays were reflected most brilliantly upon the glass of that building. These observations have been made when the thermometer has been somewhat falling, but the other conditions requisite for the production of fog have not been present in those parts of the country where fogs are usually found, and the soil, being gravel and chalk, cannot be accused of being fog producer.

In my own neighbourhood the densest fogs come from the north, and these consist of a dark pea-soup atmosphere, which renders our district most unsatisfactory, whilst it lasts, as a health resort. Similar conditions are sometimes to be met with in the most favoured places. I was at Brighton on last Lord Mayor's day. It was a beautiful day in the Weald district. The country looked lovely in the autumnal tints produced by decaying vegetation, brought out by a November sun. The north side of the South Downs were perfectly distinct in outline, without a trace of mist upon them. There was a lovely sunset as seen from the new pier; there was nothing to limit the sight seaward but the distant horizon. Not so in the town of Brighton itself. Just after sunset the lights on the north side of Regency-square could scarcely be seen from the Parade, whilst the lighted gas lamps were quite invisible at the northern ends of the streets which run at right angles with the King's-road. Yet the sky was clear, the stars shone brightly, and there was no reason for the heavy and murky atmosphere in London-super-Mare on that evening, beyond the smoky chimneys, the soot from which could be seen pouring down into the streets and squares of the place, and as these were at right angles with the wind, there was no easy escape. The wind was from the west; it freshened into a gale late in the evening, and cleared the smoke away. It is, however, a curious fact, that Brighton, which is a place beyond all others free from fogs, in the common acceptation of the term, suffers occasionally from coal-smoke and its consequences as much as any part of London, whenever there is a calm with the slightest possible amount of wind from the west. If the barometer is high, and the thermometer low, with a north wind, the setting sun is seen as a dull copper disk, which disappears from view long before it ought to be lost to sight; whilst if the wind blows on to the land from the sea, there is no interference with the beauty of the retiring orb of light. I have witnessed this phenomenon on several occasions, so that one may draw the inference that, with a still atmosphere, high barometer, and falling thermometer, with the wind from the west or north, there will be a murky cloud settling down upon the place at sunset, which, but for the sea shore, would soon render Brighton, as far as fog is concerned, little better than the East-end of London. How is this to be accounted for? I think that the 110,000 fires which are burning there, in a narrow band under the Downs, and which, as the shades of evening come upon the place, are thoroughly replenished with small

to dense volumes of smoke from almost imney, and produce this change in The cause is one which man produces is own purposes, and which, therefore, emove.

ught by some that smoke is only a minor at there are other and irremovable at smoke from coal is secondary only, moval would be useless. It is thought that we have only to put the Smoke Act nd stop the discharge of the clouds of m factory chimneys, to remedy the evil. nk that the main cause is in the marshes, far as the valley of the Thames is concur between its rise and its fall into the think that land drainage would remedy thers refer them to the clay soil which the London basin. The irremovable not account for the darkness and ss which, if such were primary parts of d be felt most on the Scotch moors and eas, but which are in reality never found one ever coughs up a quantity of matter h like a decomposed leech when out oors, or among the bogs of Ireland, has just come out of a coal-pit; one can be long in a real London anchester fog, without expectorating ently a nasty bit of filth, which shows e upon its very surface. We should se conditions most frequent in places ly to give rise to them, if water was the e; but fogs, produced in such situations, ys white fogs, and cannot be mistaken n-made fog. They may occur in London, s elsewhere; they do rise in London, no they do in all clay deltas, if the conre present which cause the descent of ke, they add very much to the dangers culties of the occasion; but white fogs the ground, and grow upwards, whilst k or yellow fogs come down. White bearable, if alone; they are not dangerous xcept in a very minor degree, which may elf in the Welsh valleys, on the Yorkshire r the lowlands by the sea.

who think that an enforcement of the Act, as it now exists, would greatly the evil, are not quite aware of the main the mischief. There are no factories in n, there are very few at work in London ays, and yet some of the worst fogs I have tnessed have been on autumn Sunday s, between the hours of ten and two. The son for Sunday fogs, is the fact that on y the London poor, and a large part of the lass, dine at home in the middle of the at there is always a good fire prepared the forenoon, by the almost simultaneous on of loose Newcastle or other small coal, a consequence of that simultaneous fire hing, there are dense volumes of smoke ery house fire in the metropolis, about the which cooking commences, which slowly into some part or other of the district. r days a great part of the cooking is done times, more of it towards sundown than in ning; but, on Sunday, it is in the morn- l, as a consequence, there is a capacity nce fog if the meteorological conditions favour it, which is not found on any other day in the week. In Brighton, the simultaneous charging of fires occurs about sundown, and the greatest volume of smoke is visible soon after sunset, when the days are shortening and the air grows cold. In the metropolis it is at midday on Sunday that there is always, if the wind is trifling and the barometer high, in some parts of the forest of houses, a cloud of unconsumed carbon, which obstructs sunlight, and in the aggregate, produces as much evil as did the pestilence of former days. Sudden deaths from the rupture of blood-vessels in various parts of the body are not infrequent, and other illnesses are common, which, sooner or later, have a fatal termination, but which are not referred in the Registrar-General's reports to the real cause of the untimely event. The effects upon human beings are innumerable. The irritation set up in the eyes leads to much individual suffering, and a great aggregate loss, whilst similar effects upon an irritable mucous membrane causes pneumonia, bronchitis, asthma, and a host of maladies, both painful and weakening. The injury to the skin is not the least part of the mischief, blocking up the pores, and interfering with perspiration, doing for man, in a minor degree, that which produces a much greater loss, to plant life, in a pecuniary point of view, and which, in its effect, cannot be estimated. I lay great stress upon the Sunday development of fog, because it is very striking to those who observe it from the outer side of the great centre. I have done this for some years, and have marked the way in which the London pall has invaded my own district, producing now and then a necessity for gaslight at mid-day, when I have been dining with my family at a distance of ten miles from St. Paul's. I have gone up to London after that, leaving behind me a dense black cloud resting upon the earth, finding it less dense at New-cross, not much fog in the City itself, and the North of London has been comparatively clear. On these occasions the wind has been calm in the morning, and blowing slightly from the north towards mid-day, and I have been told that there had been a fog in London in the morning, but that it cleared off about the time at which it invaded our district. On these occasions the barometer has always been high. One day I went down to Greenwich when Croydon was enveloped in London fog. It was not one quarter so intense at Greenwich as at Croydon. On another visit it was slight at Croydon but intense at Greenwich. The wind in the first instance was north with a point to the east, in the second it was north-west by west. In both instances it is quite certain that the wind did not cross the Essex marshes or any other marsh land before it reached either of the places I have mentioned, but the fog had simply been brought from the forest of houses which constitutes the metropolis of Great Britain. My early impressions were that the main cause of London fogs was intimately connected with marsh or clay land, so no doubt wet fogs are increased by those districts which are yet undrained, notwithstanding the incubus of an easy money market. Observation, however, has told me that only a moiety of fog is due to this cause, and that that moiety is the least injurious part. I have seen the fog grow, as it

were, within the radius of houses, coming down upon the ground, not ascending from it, presenting its first indications in too close proximity to the chimney top to lead me to doubt as to the source. Those who always live within the radius of the producing cause are often unable to see the changes which take place within the influence of that radius, but which changes are distinctly visible to those outside.

If the Essex marshes were the greatest factors in the case, the fogs themselves, in their invasion of other districts, would always have a distinct reference to some part of the Thames delta. The invasion of the table-land about Croydon and the Surrey-hills is not traceable to that source. A north-east wind does not give us worse fogs than those we get from the north and west. Our darkest fogs come most distinctly from the north; never from the east or south or west. I can predict with certainty the presence of dense fogs in Bermondsey and the City without visiting those places. They are always bad on those spring mornings when with us the air is clear, the sun shining brightly, and not a cloud in the sky; there has been a morning frost, the wind being distinctly south, but moving very slowly; our season ticket-holders on the southern lines then know that, as soon as they get into the New-cross cutting on the Brighton line, they find a dense fog, which grows darker as they get to Bermondsey, and in the City the gas is necessary. A white and wet fog does not by itself ever produce a necessity for gas, but when the smoke comes down as the white fog rises, there is difficulty, danger, and darkness all around.

These fogs are perfectly free from any suspicion of mixture with air from the Essex marshes. The simple fact is, that the smoke shuts out the warmth of the morning sun, which is reflected back again from the cloud below the chimney-pots, instead of warming the earth. I have known, on several occasions, a complete change of wind take place towards the middle of the day, the course being from south to west, then to north-west, finally resting in the north. With that change the sun becomes obscured, and is only visible as a dull copper disc, a cold raw feeling pervades the place entirely banishing the genial air which had so delighted us in the early part of the day. The change has brought us London smoke and London air. The sun loses his beauty and his warmth much more effectually than when clouds of the proper kind obscure him. He only shows a dull, copper-looking disc, which is very conclusive as to the presence of particles of unconsumed carbon in the air. The copper-looking appearance is quite different to that which arises during its natural eclipse; it is somewhat like it, but it produces a much colder feeling in the air, and makes one feel positively miserable and wretched.

The moon also tells us very clearly when the air is loaded with fuel smoke; its colour is altered, its silvery appearance is lost. It is quite different to that appearance which it presents when simply obscured by light fleecy clouds, themselves a near approach to an ordinary fog.

I have a suggestion to make as to cause. I have not been able to prove the truth of the suggestion, for it requires electrical apparatus which I do not possess, but it appears to me capable of explaining the development of smoke fogs. Diffused electrical charges, concentrated over a small area, must be taking place in large cities from chemical acts, from the various manufacturing agents always at work, from magnetic developments consequent upon the close proximity of 3,000,000 people, probably as many animals, and, in winter time, certainly as many fires. This electrical development may be suddenly manifested in one direction at one time, in another direction on another occasion. Is it not possible that it may produce those atmospheric calms which occasionally precede local thunderstorms over our great towns? Is it not possible that the 3,500,000 fires which are sometimes lighted in the metropolitan area, and which cause a rush of hot air upwards, being positively electrified, may have a repulsive action upon the unconsumed carbon, in a negative state, and cause its rapid descent towards the earth, but to which it is not attracted? This might account for the reason why these fogs arise when the barometer is high rather than when it is low. The surface of the earth is colder than the upper regions of the air, and that coldness is not dissipated because the rays of the morning sun are reflected from it by the surface of the cloud, or are absorbed by the particles of carbon. One would expect the exceedingly light organic particles to go up with the heated air; there appears to be a repulsion between the particles of carbonic acid and the soot particles, for the air which contains excess of soot does not always contain excess of carbonic acid. There does not appear to be more carbonic acid in that which floats away from a chimney-top, than in that air which is collected at a corresponding resistance (40 feet), from the chimney, but which is comparatively free from smoke. It might be thought that the largest quantity of carbonic acid would be found close to the surface of the earth, from the greater specific gravity of its particles; but this is not so. There does not appear to be more carbonic acid close to the ground, than when the air has been collected twenty feet from the surface. With soot, the rule is contrary, the densest parts of stationary smoke fogs are nearest to the ground. This density shows itself in several ways. It obliterates light completely; but the most curious effect is the obliteration of sound, which prevents one from perceiving the approach of moving objects until they are close upon you, and moving vehicles suddenly appear like ghosts upon the scene; a noise upon the top of a building is heard much more distinctly than one near the ground. On the September Sunday to which I have already alluded, the noise from the traffic in Oxford-street was heard much more clearly than that from the middle of Park-lane, although I was in a part of Hyde-park much nearer to the latter than the former; at the same time, vehicles passing by the Wellington monument, where the fog was thickest, could not be heard at all.

It is reported that a so-called dry fog is sometimes observed in Belgium, where it is called bog or heat smoke, and is imputed to its right cause, viz., the combustion of peat grounds. If we could eliminate the particles of solid matter from the atmosphere, London and other large towns would be no worse as regards fog than other places, and

districts which, like Croydon (in reference to winds), are to the leeward of the great would not suffer in the way we do now from petual burning. There are some points con- with the subject which have been raised by fic men, into which I need not enter. I ommitted myself to the theory that it is , caused by the destructive distillation of ad other fuel which causes the greater part of ril; that it is not a "radiation fog" or a ch mist," or simply a mist from the bosom ther Thames or the Essex marshes, or the n clay. The literature which has been hed regarding fogs is not extensive. My Mr. Dines, read some practical remarks lew, mist and fog, before the Meteorological r, which is published in that Society's l for July, 1879, and which contains almost as nformation upon the subject as is generally . Mr. Dines also says, in a letter to me, 'It is now pretty certain that the fog grows ds, and that just above the fog the air be- (rather abruptly) several degrees warmer." n also adds, "at present I cannot make up nd whether the roofs of houses, slate and diate like grass, and so cause mist and fog; re bad conductors, and, therefore ought to d radiators." Mr. Dines also adds, "that, opinion, the water has nothing to do with n fogs!" In this opinion I concur. It is hat the immense combustion which takes from fire and gas in London, naturally pro- an immense quantity of watery vapour, is precipitated at times from the chimney s fog. Whether this is so or not, will in no nterfere with my conclusions, for that fog . be a white fog, like the steam from a loco- e, if no carbon or hydro-carbon were discharged t. Dr. Frankland is of opinion that the water les become coated with votatile hydro-carbon, than with soot. This cannot be borne s true on all occasions. The matter filtered air, such as that of September 26, contained more solid carbon than volatile oil, as a few h experiments with cotton wool easily proved. ize of the particle of water in the mist or fog no consequence, because I contend that, if the ctive distillation of fuel, as now conducted in fire-grates, could be limited, the noisomeness ondon fog would be done away with; and it outside my point to take up your time with details. The radiation from roofs may be a aining point in changing the direction of a tic current, and may, perhaps, produce nt magnetic states in the air above our great , as compared with the mass of matter below, worthy of a thought. It may be a determining as to white fog or no white fog, but there is actical result to be gained from considering ome wise men ridicule the notion that uncon- l carbon is the cause of a London fog, and write that the quantity of carbon in a cubic f air is so infinitesimal as to be almost g. Need I say that my engineer critic is ly not aware that a difference of only 200 in a million, or only one grain in 5,000, in e of carbonic acid gas, and even a smaller ity in the case of oxygen, will make all the nce between a healthy and an unhealthy phere, and on his own showing, the effect of smoke in deteriorating the air is far greater than this. My critic convicts himself as being in the position he wishes to place me in, when he accuses me of ignorance of my subject.

Most elaborate tables have been prepared to show us the quantity of sunshine which Providence has bestowed upon us during the past year, and a good inference has been drawn, indicating that each hour of the sunshine has been worth "so much." Let me ask how much sunshine has fuel smoke deprived the Londoner of, during the past two or three years. How much sunshine has this country been deprived of, and how much has vegetation suffered from this cause. Let any one stand, as I have done this autumn, upon the Cumberland mountains on a fine day, note the position of the wind, and if it comes from one of our manufacturing districts, he will observe a haze which limits vision, and which an air filter will show to be due to organic matter, referable for its origin to the destructive distillation of coal and other fuel. I have watched the smoke from the Lancashire and Cumberland factories, finding its way across the sea, in a distinct cloud-like mass, which, impinging upon the distant hills, has shut out sun-light as effectually as if it were London fog. How much it interferes with vegetation is patent to every one; and one has only to walk through a field of cabbages, in the neighbourhood of London, when wearing a pair of white continuations, to get evidence enough to prove the truth of my proposition, without requiring philosophical instruments for the purpose. Is it not ridiculous for anyone to assert that this effect is a trifle? How little can such critics know of the economy of nature; how little can they appreciate the goodness of the Almighty, who has, in vegetation, given us a means whereby we may cause the removal of the natural impurities that must arise in air, viz., the carbonic acid and albumenoid ammonia, which must be produced where people most do congregate. We impede that vegetation by our carelessness or our cupidity, and that which might make our cities much more beautiful and much more healthy than they are, can scarcely get a footing in our midst. But it is not vegetation alone which suffers. As I have said before, the life of man himself is materially shortened, and much mischief results to him in various ways; not only man, but his own works are rendered less durable. The injury to works of art is manifest. The glass shades over the frescoes in the Houses of Parliament, the condition of the masonry of the houses themselves, the crumbling outer halls of Westminster Abbey, the roughness which has replaced the smoothness of works of art in the old Abbey, and even in St. Paul's Cathedral, all points to the presence of matter in our atmosphere which the chemist tells us to be sulphurous acid derived from coal. Then look at the hideous erections with which our houses, and especially our public buildings, are disfigured; smoke preventers, smoke curers, horrible contrivances put up in the higher regions, pretending to make the rooms below in a habitable state. It would be interesting to know how many architects have been consigned to lunatic asylums, in consequence of this incubus upon their architectural works. A survey of London from the top of one of the high buildings in its midst, is one of the most extraordinary spectacles which can be conceived.

Tubes of the most outlandish shape, and most peculiar construction, obtrude themselves everywhere, and can probably only be equalled by a similar state of things in the underground drains. The aim and object of these hideous excrescences, both above and below ground, would appear to be to make the atmosphere, subsoil and aerial, as unwholesome as possible.

There is an important point upon which men differ considerably, viz., are fogs worse now than they used to be in former times? Several correspondents have assured me that they are no worse now than in the early part of the century; but need we argue this point? Given a clear sky, a high barometer, a falling thermometer, with but little wind, and there is not any day in the whole year in which a dim atmosphere will not be found at sundown somewhere in or around London. Can any one assert that this has always been a feature of the metropolitan district? Dense fogs, no doubt, have at times always occurred, and are primeval; but there are no substantial facts to show that pea-soup fogs are so. They stick to the point of origin; they may invade other districts at a distance; but when London was only a tithe of its present magnitude, were scarcely perceptible ten miles away. This is borne out by a verse which Gilbert West put up in an harbour at West Wickham, a village four miles to the east of Croydon, and which I find in Garrow's "History of Croydon"—

"Not wrapt in smoky London's sulph'rous clouds,
And not far distant stands my rural cot;
Neither obnoxious to intruding crowds,
Nor for the good and friendly too remote.

And when too much repose brings on the spleen,
Or the gay city's idle pleasures cloy,
Swift as my changing wish, I change the scene,
And now the country, now the town enjoy."

This verse, put up a century ago, would hardly now apply; sulphurous clouds reach much further than West Wickham, and we in the suburbs cannot so easily escape from a nuisance even then recognised as peculiar to a great city.

Only a week ago, a veteran member of the Strand Board of Works is reported to have said that some fifty years since wax could be bleached at Hammersmith and Shepherd's-bush, but that now wax-bleachers have to go much further away from London, before they can get sun-light sufficiently clear to effect their object; London smoke interferes effectually against the particular industry of wax-bleaching. Was there ever such a fog in South Kensington, before it became the dense suburb that it now is, as was seen there on the second of this month? I will, however, now leave the consideration of the cause, and try to suggest a remedy.

It is much easier to point to a nuisance than to get it removed; I always object to criticism, unless it shows a better way of doing things. I object to overthrow an institution, without being provided with something better to put into its place, even if that institution is a nuisance. The overthrow of the domain of fuel smoke might be purchased too dearly. There is something so endearing and so national about our domestic hearth, so captivating about the ability to poke a fire, that I should never expect to remove these comforts from our midst; neither is entire removal necessary. The ability to poke a fire is the one thing which preserves many a mind from downright insanity, and to take away the power would consign many an unstable mind to a madhouse. The thing is not to be done, therefore, without due consideration. Thousands of fires, nay tens of thousands, would not produce a London fog, spread about, as they might be, over the 300 square miles which constitutes the metropolitan district. A few such fires would do harm, and if such fires, being a luxury, were made to assist in performing a duty towards those who could not afford the luxury, good might come out of evil; though I would not support the notion that it is right to do evil that good may come. The question is how are smoking chimneys to be got rid of. It is a process which the Society of Arts, with all its array of powerful names, will not be able to effect. An appeal must be made to the Legislature upon the point, and I suggest that the Society be foremost in making that appeal. Let us ask them to pass such laws as will help forward the object which we have in view, for public opinion, public spirit, and philanthropy will not alone be able to effect it.

I believe that a short Act would be sufficient. That if local authorities had the power to levy a tax upon every fire-place so constructed as not to consume its own smoke, the smoke nuisance would disappear in a very few years. They should have the power to use the proceeds of that tax in the purchase of the gas and water works of the district, and so enable local authorities to provide the capital necessary for the purchase of these works without having to add materially to the local rate. Gas, like water, has become a necessary of life; no large town can carry on its work in the world without gas. It is false political economy for dividends from gas and water to be paid out of the life-blood of the country. Its property should provide the capital for the purchase of such works. That capital should be sunk at once, and the consumers of both gas and water should only be called upon to pay the cost price of the product, with such other charges as might be sufficient for the maintenance of the works in an efficient state, and when extensions are required, the property requiring the extension should pay the cost.

The practical experience of large consumers tell us that gas even now can be produced in the neighbourhood of London at 1s. 6d. per 1,000 feet if the charges on capital account are kept out of the balance-sheet, and they publish the fact in their own accounts. I take it, therefore, that 2s. per 1,000 would cover the expense of production, distribution, and maintenance; and if gas was supplied at that price in London, it would soon find favour as a cooking and warming agent, and would greatly assist to extinguish the smoke fogs (provided means were taken at the same time to put an efficient law in force against some of the most notorious of the company offenders). There are, probably, 4,000,000 fire-places in the metropolitan district; an average tax of 20s. upon each of these, payable after two years' notice, would cause the removal of three-fourths of them, and the remaining million would provide a fund which would, for a time, go some way towards paying off principal and interest upon the purchase of the London companies' claims in their works. If three-fourths of the fires were deprived of their smoke, the atmosphere of London would be deprived of much of its noisomeness. This might be still further diminished by rendering it incumbent

pon those who continued to have open fire-places burn only that coal which had been partially prived of its smoke-producing qualities. Indeed, e sale of any other coal to private consumers ight fairly be prohibited, and a considerable crease might be made in the coal dues upon that rt of the coal which continued to be distributed ithin the metropolitan district when that coal as intended for consumption in open grates. hese charges would, in a few years, remove ineteen-twentieths of the noxious matter which s now discharged into the atmosphere of the etropolitan district. It is probable that the production of a fog is something like the production f a frost. The temperature must fall below 32° efore a frost begins at all. If the temperature is high, the reduction for a degree or two of no consequence. It is only when near to e freezing point that it becomes important regards the production of ice. So it is also robable that, to produce fog, there must be a ncurrent smoke from a certain number of imneys within a given area, and if that number not reached, there will be no fog, even when eteorological conditions are such as may favour s production.

My proposition will be met by innumerable bjections; all great social changes are so met. It only by answering those objections, or showing hem to be unsound, that real progress will be made.

First, then, as to gas fires, which I suggest as lternatives for open fire-places. I am told that hey are injurious to health, that they are comfortless, that they make the air of the room so dry, hat they smell offensively, and that the heavy gases which are formed at the base of the fireplace will find their way into the room. These are air arguments against bad workmanship, but are not sound as against gas fires. I have had a gas fire for some years in my consulting-rooms and library, and no one, at first sight, can know it from an ordinary coal fire. It never smells, and warms a large room thoroughly; there is no dust, and no work for the housemaid to do, and no destruction of books and papers from dirt. But I must not poke it, and I must not burn rubbish upon it. These are, next to its cost, its only disadvantages. A gas fire cannot dry the air of a room to a greater degree than any other fire. If a smell comes from it, the fault is in the work or the stove construction, and would happen at the same place with any other material. If I had gas in all my rooms, I could do with one servant less in my household. Chimney sweeps, who are now necessary adjuncts to every house, would find their occupation gone, and the mischief which soot and dust produces in every house would not arise. This would effect an enormous saving in our domestic outlay, and our domestic works of art would last much longer than they do under our present *régime*. Common grates need not be removed, gas fires can be fitted to any ordinary grates, and the only expense need be the cost of laying on the gas. I shall be told that it will be quite impossible for the poor to do this. It is not a thing which the poor should be called upon to do. The tax upon open fire-places should fall upon the landlord, and in the case of weekly tenements, the landlord should collect the charge for gas when he collects his rent. If the rent is not paid, he should have the remedy in his own hands, by at once cutting off the gas supply. I am so satisfied of the power of our stove manufacturers to meet this point, by constructing stoves which should give a maximum amount of heat with a minimum amount of gas consumed, that I should hail the change as one giving an immense boon to our labouring population, by providing them with warmth without waste, and taking from them that tremendous source of dirt which smoke produces among them, and which manifests itself upon the faces and clothes of the children of our poor population. The pocket saving would not be the least part of the work, for no one can watch the waste which the poor man has to suffer in his efforts to make a little fire to burn up, without feeling that the change would be very much to his interests. Whilst, as far as the gas rental is concerned, the poor should be called upon to pay the average weekly cost in advance, just as they now have to pay for the coal before it is consumed. There would be no injustice or hardship in this, provided the law gave them a right to a drawback upon that which they did not consume. The enormous advantage of a gas fire in a sick room has only to be felt to be at once appreciated. There is no waking up the patient by having to poke the fire and put on coals; there is no sudden discovery that the fire has gone out whilst the wearied nurse has slept, at the moment, perhaps, when it was very important that the air of the room should not get chilled. Indeed, the advantages of being able perfectly to regulate the heat of the room in such cases is immense. Those who do not like a gas fire need not be obliged to have one; they may find a much cheaper substitute in the beautiful slow combustion stoves which are now very generally manufactured. I would especially refer to those of Mr. Doulton, at the Lambeth Potteries, and which are formed of fire-clay; I prefer these to those made of iron. The fire-clay radiates heat much better, without depriving the air of its health-giving qualities. No one can have compared the heat given out by a common fire-place, having a fire-brick back, with one with only an iron plate, without at once giving the palm to the fire-clay material. These stoves provide that nine-tenths of the heat produced by the fuel consumed shall be utilised in the apartment, and not sent up the chimney, as is now done from ordinary fires. These stoves are a great advance upon the ordinary iron stoves. The air is not altered in its character by coming into contact with hot metal. The stove is not a nuisance in its appearance, but may be made an imperishable work of art, which will bear ill-treatment, and only want washing when dirty, instead of paint or blacklead, which, when used, smells most abominally all over the house. I think it very important that the use of fire-clay should supersede that of iron. Coal, as now burnt, is burnt to waste; in all other fire-places, and in great numbers of ordinary stoves, the heat generated is dissipated in the air above our houses. There was a scare some time ago regarding the exhaustion of our coal-fields. The bare possibility of such a thing should lead the Legislature earnestly to consider the fact that not more than one-sixth of the coal, now consumed, is usefully employed, and its waste might very fairly be prevented.

There is also another question which this change would solve, and which would be of immense advantage to the local authorities of the metropolis. Tens of thousands of loads of ashes which now block the dust-bins, and are such an incubus to the Vestries, would then have no comparative existence. The organic matter which the Vestries would have to collect and to dispose of could be easily dealt with by fire. There would be other changes besides a purer air; it would give relief to the traffic of our streets by taking out of them the long array of coal waggons and dust-carts which now delay other and more important traffic; and the Vestries would find a solution to a question which at this moment is exercising their ingenuity to a very serious extent, without their being able to find a solution for their difficulty.

Then look at the architectural advantage in an æsthetical point of view. Imagine London without those productions called smoke preventers, and those hideous chimney stacks which spoil all proportion. Think of the incubus which would be removed from the architect's mind when he felt satisfied that the chimney doctor would not be required for the purpose of spoiling the appearance of his edifice.

It will be urged that taxes of the kind proposed, are all wrong—that it is going back to a tax which, once upon a time, produced rebellion in our land. Then the window tax is instanced as one which had to be given up. But the window tax was quite the antipodes to the smoke tax; one was the means whereby light and air was shut out, the other is not for the purpose of raising a revenue, but to put down a nuisance, and to lead to the purification of the air. I propose a tax in preference to a penalty. Penalties require persons to enforce them. The infliction of a penalty is invidious, when it has to be enforced against our neighbours and our equals, and when it is possible that the magistrate himself may be an offender against the law. There are many difficulties which are shown in those places, in which the smoke nuisance from manufacturing premises is even now allowed to continue, in spite of the Smoke Act —and why? Because the members elected to serve on Local Boards are themselves offenders against the Act; and the magistrates who have to enforce the law, are themselves law-breakers in this very matter, it follows that in places like Warrington, Wigan, and Manchester, the law is defied and penalties not enforced. This would be even more certain to follow if there were to be penalties for smoking chimneys. But make it a heavy tax, which all who do not comply with the law must pay, and the difficulty vanishes, as far as the money question is concerned.

The power to proceed against the manufacturing offender should be placed in the hands of a public prosecutor, and should not be left with the local authority who, as at Bow and Stratford, allow the law to be a dead letter, because if enforced, it would be upon the members of the local authority or their friends that it would have to be levied.

Any law for the reduction of the smoke nuisance would only be partly effectual which did not touch most heavily the greatest offenders, viz., the railway and steam-boat companies. One great reason for the greater intensity of fogs in the present day is the fact that, as soon as a white fog settles down upon the metropolis, if it be attended by a falling barometer, thousands of cages are brought out all along the railway lines, and are banked up with small coal and breeze instead of coke, and which give out dense clouds of smoke. They tend to render traffic on the railway more difficult than it is elsewhere. These cages contain fires ostensibly for the purpose of warming the watchers who signal the trains. I say ostensibly, but that they do not effect their object is but too evident from the appearance of the poor men themselves. If, instead of providing such fires, the companies would provide the men with proper dresses, such as arctic voyagers wear, there would then be no occasion for the fires, and the men would be much more comfortable. In addition to this change, which humanity ought to dictate, it should be a public prosecutor's duty to compel companies to run engines which really consume their own smoke, and the dense volumes of black smoke from steamers on the Thames should be ruthlessly put down.

I know that my proposals will raise up a host of antagonists, especially among those who believe that they are owners of a patent or a fuel which, if Parliament would but compel the people to use it, would stop the nuisance. I think my proposal will promote their interest much more than any legislation in the direction they contemplate. A still more powerful opposition will arise from those who believe that they have vested rights in the perpetuation of the nuisance, not the least of which ought to come from the sweeps, an honest and industrious set of men, who would suffer most from the change; but the most powerful opposition would be from those who are profiting by the mischief, and making immense sums of money by the perpetuation of the nuisance. I am in doubt as to the best mode of proceeding; but this meeting will, I feel sure, endorse Mr. Micawber's opinion that "something must be done," without following that gentleman's example, but will advise that action be taken of a determined character. I would propose that the Home Secretary be approached, and that he be urged to procure the appointment of a Royal Commission to inquire into the whole subject. I have put before you my own views under three heads. They are—

1. The causes of the intensity of town fogs.

I refer these to fuel smoke, which I contend to be an unnecessary adjunct to fire. That the method now used for warming our houses and cooking our food is wasteful in the extreme, and five-sixths at least of the developed heat is lost, and much of the fuel passes away unconsumed.

2. The means which should be adopted to prevent these causes continuing in operation.

These means should be the production of gas at a cheap rate, so that it might be used for cooking, and in many cases for heating purposes also.

In reference to this point, I would observe that the use of gas for lighting purposes will pass away; it would be to the interest of the companies that heating power should be developed in the gas manufactures rather than lighting, and that it would be promoting the object we have in view if the sale of coal was prohibited in the metropolitan district, unless it had been previously deprived of its smoke-producing

That a tax upon fire-places not so con- as to consume their own smoke would is object, which might also be assisted by r tax upon the untreated coal when sold ic consumption in the metropolis. That eeds of these taxes should be used by the hority in extinguishing the present com- companies who manufacture gas and dis- rater. That the use of closed stoves should raged as much as possible.

at the steps which should be taken to pro- ese objects would be best met by urging e Government the propriety of appointing l Commission to inquire into the whole and who should formulate the grounds nich legislation should be established, and the way for the introduction of a Bill into ent for the purpose.

DISCUSSION.

hairman observed that Dr. Carpenter, in his paper, had noticed the existence of fogs in the But for the existence of such fogs in the Legis- in 1855, the metropolis would have been, in rt, relieved of the evils in question some years r clear measures had been prepared, which, in e, must be resorted to now. He (the Chairman) ered, as one of the first incidents of his sanitary a local officer pointing out to him from an e, in a rural district, a white fog which at -tide was spread evenly like a blanket over a eneath. That regular fog, the medical officer covered the bulk of his patients. Outside of he had scarcely any but midwifery cases and a. Such fogs are always lowered and frequently l entirely by the process of land drainage. The of the sewer gases and of soot to the rural uld compound a fog of much the same primary s as the London fogs. A great part of the -covered site of London was supersaturated with ed waste water, amounting to forty or seventy s of gallons daily. The death-rate from attacks mic disease in the lower levels of the metropolis und to be double the rate of attacks in the higher which, however, were subject to the ascending ions from the lower levels, as well as from inter- flat tables. Then there were the stagnant sur- full one thousand miles of sewer of deposits, as s of bad house-drains. The whole of this of contamination would have been removed by option of the self-cleansing system of imper- sewers proposed, and removed at half the of the stagnant system. The effect to be d by the substitution of a self-cleansing system same as that produced by heavy storms, when the unusual freshness of the air they breathed. here was, outside the covered areas, extensive f marshy land, so named, the Essex and other s, which would be benefited in increased pro- by subsoil drainage. Fogs occurred in the t amount when the wind was easterly; and on occasions, marsh diseases and ague were more it (for the most part in the portions contiguous marshes but extending to the western parts metropolis) than was supposed, as deaths, ting in the marsh diseases, where not entered h in the registers. For the reduction of these rising from supersaturated subsoils, the methods soil drainage, by pumping for the whole of etropolitan area, the lower tracts in the the covered area, and the subsoil drainage continuous uncovered area, the eastern and other low-lying marshy land was prepared for that land at a remunerative expense, and for the inside or covered area at an expense of about 9d. per annum per house for the extra pumping, the effect of which would be the same as if the whole site were elevated a number of feet. The engineering principle of the arrangement was similar to those in the Fen districts for sending the rainfall to the rivers, one sanitary effect of which was that where pounds of bark were formerly used, only ounces were now used against ague. They had no experience of fogs in dry weather or from soot alone, without moisture or damp, such as arose from supersatu- rated soils, an evil they had always with them. Rich- mond-park was once the seat of heavy fogs, from which it has been almost entirely relieved by drainage, and the health of the deer and cattle improved, and it would probably be relieved entirely, as also the other parks and open uncovered spaces, by a better system and work. The subsoil drainage of the site of Birken- head had cleared away fogs there. At Liverpool, the reduction of damp, by the reduction of the supersatura- tion, by the reduction of the waste of water, is reported to have caused a material reduction of the death- rate. The measure for the removal of stagnant sewage and its evaporation, and sending the sewage, not to the river, but to the land, had been started by the German engineers, and was now in the course of successful application there. The next evil of which an examination had been entered into, but not carried very far, was the smoke nuisance. For this, the use of smokeless coal, such as anthracite coal, was indicated, and on this topic the National Health Society had entered into a very promising course of inquiry, for which public support was needed. The Society of Arts had conducted an inquiry some time ago for the award of a prize for new inventions of grates and ranges that consumed the least quantity of fuel; but it was found that the new inventions did not excel, and were often the same as old inventions which had never got into use; and they never got into extensive use at all, on account of the first expense of change. The compulsory measure advocated by Dr. Carpenter would be available as a motive for the purpose, but the Board of Health contemplated also the use of half-coked coal, which would have the quality of anthracite. They also contemplated the ex- tended use of coal gas in houses for warming as well as cooking and lighting. This extension appeared to turn mainly on the reduction of the price of gas, and that by putting the supplies upon a public footing and public arrangements. The first obstruction to the extension of the use of gas apparatus, as well as new fire-places, was the selection and the cost of the apparatus for distribution into houses. For remedy, it was contem- plated that the company, or the lighting authority, should substitute the apparatus and keep it in good action, for a rent, as was now done with gas meters, and, indeed, as had been done with great success in a provincial town for the whole apparatus. Instead of having to pay at once some six pounds, the occupier would only have to pay a rate of some six shillings a year, with the security of attention to the fittings. Measures could not be expected to be adopted without examination and preparation, and for examination and preparation a competent service must be appointed, provisionally, for the examination of the subject, which was more complex than might be supposed. But then it had to be determined what apparatus was the cheapest and the best. The chief gas company in London, for its own interest in the extension of the consump- tion of gas, would have promoted competition for the cheapest apparatus, but it was decided by the Board of Trade that they had no power to do so, and the Metro- politan Board of Works opposed their obtaining power. Power was also required to get the cheapest apparatus for cooking, and for warming and ventilating by gas, for warming by an apparatus that warms the pure air

which it pumps in, and removes the vitiated air. One thing is attendant on the introduction of gas into houses for warming—that there is a considerable reduction of the smoke, dust, and dirt within the house. One thing has not hitherto been attended to on this subject of the smoke nuisance, and that is, the washing bill, which may be reduced, under good conditions as to smoke consumption, and the washing bill for the metropolis may now be estimated at full six millions and a-half. Dr. Carpenter had talked of the amendments proposed, as requiring much money. Now when fully examined, it would be found that the measures, which were sound in sanitary principle, really saved money. If he (the Chairman) were now in office, with full executive powers, he would set aside his own particular measures, and the measures proposed by others of his time, and re-examine them, and prosecute the subject *de novo*. He agreed entirely with Dr. Carpenter's conclusion for the appointment of a Commission to examine the whole question, as the speediest means of obtaining efficient relief.

Mr. Robert Rawlinson, C.B., had listened with great pleasure to Dr. Carpenter's address, and agreed in the main with his proposals. He had explained the existence of fog in a very lucid manner. It did not always arise from vapour, but it did frequently, and in those cases, the removal of subsoil water by drainage would often abolish it. They knew that large areas were often covered with dense fogs in autumn and winter, but when these were drained, the fogs diminished. Every cubic foot of water removed, which would otherwise evaporate as vapour, allowed as much heat to remain as would raise two million cubic feet of air 1°; and when land was effectually drained it had been asserted that the mean temperature was permanently raised from 4° to 6°, and consequently it was equivalent to removing it a certain amount farther south. Dr. Carpenter had mentioned a fact which he also had often noted, though he had not understood it, viz., that fogs commenced with a very high barometer. One would have imagined that smoke would rise more readily in a dense atmosphere than in a light one, but it was not so. As soon as he saw the barometer begin to rise in autumn and winter, he knew he must expect a thick atmosphere. He did not think the remedy proposed, of imposing taxation on fire-places, would be practicable. Englishmen were, very properly, irritable under taxation, and he thought the Legislature must find some other means of diminishing the consumption of coal and the production of smoke.

Mr. G. J. Symons, F.R.S., said this was the first time he had said anything about fogs, though he had studied their conditions for many years, having been all his life in a good position for such study. It was assumed that fogs were increasing, and were much worse than formerly, but he thought that was only another illustration of what was often found, that present evils always seemed bigger than past ones. We had just passed through half a dozen exceptionally wet years, and, consequently, the surface of the metropolis, which is yet undrained, had been in a wetter and colder condition than usual, and the result was to give an exceptional intensity to fog. He was quite prepared to say they had more fogs last year than usual, but as to their being very much worse, he doubted it. He would not occupy time by giving specimens of the fogs of bygone years, but he recollected some quite equal to anything we had had lately. Taking South Kensington for instance, he lived near there all the early part of his life, and his father went snipe shooting where Victoria Station now stood, and in that district, at that time, the fogs were quite as bad as they were now, though he was not prepared to say they were not whiter. There was no doubt that the carbon in the atmosphere did make the fog yellower, but he must leave it to medical men to settle how far that carbon was really injurious. He was rather sorry to hear the reference made once or twice to the magnetic condition of the atmosphere, for there was a tendency, whenever we did not understand anything, to hook it on to either electricity or magnetism. He would suggest that when we did not know, it was better to acknowledge our ignorance at once. He was not by any means charmed with the suggestion of referring this question to a Royal Commission; he had, unfortunately, been a member of two or three deputations lately to different branches of the Government, and, really, if they were to take up all the questions which were brought before them, and which they were expected to settle off-hand, he pitied them. He feared the appointment of a Royal Commission was rather the way to get a thing shelved; you got a wonderful Blue-book, which hardly anyone read, and, as a rule, nothing was done. He agreed with the remarks about gas fires; but in connection with them he had one grievance, which he believed was common to all who used them. He was quite sure the gas companies did not consult their own interests in giving such a low pressure during the day-time, the consequence of which was that when you wanted a good gas fire you could not get it, though in the evening, when the room was warm, you had a very good one. There could hardly be two opinions as to the advisability of gas companies turning their attention to the supply of gas for heating instead of lighting purposes; and he was glad to find, when at Exeter recently, that the gas companies there were thoroughly alive to the importance of this matter. With regard to the relation of fogs to barometrical pressure, it was generally known to meteorologists that fogs were found in the time of an anticyclone, which meant a heaping up of the barometer, just as a cyclone meant a diminution of pressure. Of course London, like other places, got a greater prevalence of fog when it got a greater prevalence of a high barometer, and they had an anticyclone of that character last year, and it was accompanied also by a low temperature. You must have low temperature and high pressure to get fog, and still more, you must have a cold state of the ground. Mr. Rawlinson was perfectly right in laying stress on the question of drainage, because the drainage and consequent warming of soil must diminish the amount of fog upon it. He would suggest the possibility that the very large amount of ground which had been built over, paved and drained, and recovered from its natural state, must perhaps, to some extent, have tended to keep the amount of fog constant; because while, on the one hand, there was more smoke from the habitations, on the other hand, there was a smaller area of evaporating surface. The only other remark he would make was one, showing that London was not alone in its complaints as to the increased prevalence of fogs. The anticyclones of last year prevailed over the whole north-west of Europe, and he heard from a Parisian friend the other day, that of late years they had had a very remarkable development of fog in Paris. After a very careful investigation, the Parisians came to the conclusion that they had had it ever since the Prussians came there.

Sir Francis Knowles F.R.S., said this was a most important subject, affecting not only the pockets of the people, but their health and the length of their lives. He wished to support, as far as possible, the conclusions to which Dr. Carpenter had arrived. An ordinary coal fire was generally left to burn rather low, then the door was opened, letting in a fierce current of cold air, and the housemaid piled on a heap of coal, which left all the inmates of the room in the discomfort of a glacial period until it burned up. He had made some calculations as to the result of the coal consumption in London, which were as follows:—The annual consumption might be taken at about 8,000,000 tons, or a daily consumption of 22,000. The ammoniacal liquor from bituminous coal was about

per ton, and deducting 13 lbs. for ammonia, out 166 pounds of watery vapour per ton of 16½ gallons. In other words, there were lbs. of ammoniacal liquor daily ejected into phere, with a due accompaniment of coal-tar s. The injurious influence of this on the y organs needed no proof, but prize cattle known under its influence. Turned into , the watery vapour of this liquor amounted or 51,194,880 square feet, one-eighth inch in representing a most respectable daily rainfall. mputation did not show what was the cause he did not think anything would. The this ammoniacal liquor was most serious. fields contained an enormous supply of nitro- atter, which, properly applied, would convert of England into a garden; and from a calcu had made, he estimated that the ammonia om the combustion of coal in London alone was e production of six million quarters of corn. Ex- at to the whole country, would give some idea ct of this waste on our agricultural prosperity. e ago he tried an experiment with carburetted from peat on red hematite ore, and, at the e hour and a quarter, when he drew the charge retort, he found mere charcoal at one side, and er the carburetted hydrogen had reduced the almost to the condition of a metallic sponge. ved how advantageous it would be partially to coal, employing the gas in this way, before it to London for use in fire-places. There modes of avoiding the evil of fog, viz., hydrous coal, or anhydrous gas. In any nsuming apparatus which might be devised, suggest, lastly, that it would be desirable to ome means for condensing and utilising the .

ggins thought the proper distinction to be kept was that between fogs and mists, the latter ated by nature, and the former by man. Then ion arose, was it possible to prevent London great deal had been written in the papers on ect lately, and one correspondent had stated that e more frequent now than they used to be in the rhood of Lord Holland's park than formerly, hat park was not drained. Now, he disagreed t, because the greater portion of the park was on a was therefore drained naturally. The ground in hbourhood of Kensington had been so covered ses and roads that fogs there, and in the whole estern suburbs, were nothing to what they were is recollection. Fogs existed all over Europe; ecollected about 30 years ago being in Paris, e densest fog he had ever seen prevailed for an ek. Only last week he read in the *Times* that re, for several days, unable to get into Havre, nt of the fog, and he had often been delayed med when coming up the English Channel by cause. He admitted the blackness of London t did not think they were as bad as they used to s for the proposed remedies, he dissented entirely . Carpenter's conclusions. In the first place, e Secretary would laugh at them, if they went nd proposed that he should put down fogs by a tax on fire-places, or by compelling people gas, whether they liked it or not. Gas was an le fuel at present for general use, for many In the first place, the mains would not be ough for the supply, and the companies would ble to raise capital sufficient to relay the whole m; on the chance of the public using it when . He had had a gas-stove in his house for the years, but it was never used; and as for gas st of those who had tried them knew that they gave was a minimum quantity. There a great risk of smell, and danger from the great difficulty in getting good gas-fitters. They had quite enough gas explosions at present to render it very undesirable that the risk should be further increased. With regard to cannel and anthracite coal, they had been tried in ordinary ranges for forty years, and were a complete failure, except in the case of a very large fire, and then it required to be lighted and supplemented with ordinary coal. Then they were asked to stop the smoke that came from locomotives and steamboats. If Mr. Bramwell were there, he would tell them, that any one who could devise a means of doing so, would make a million of money; but the ingenuity of man had not yet succeeded in bringing forward an invention which would answer the purpose, and therefore it was useless to approach the Government with any such proposition.

Mr. Bamber then exhibited and described the grate, with a solid dead plate instead of the under grating beneath, which had been invented by Dr. Siemens for burning coke, thus preventing smoke. The fire burned only in front, where the heat could radiate into the room, the heat being withdrawn from the back, where it was of no use. This was effected by means of a copper back, which conducted the heat to the under portion, and through a copper frill work, which heated the air passing up by means of a vertical passage in front of the copper frill work, and a horizontal passage below the dead plate, into the front of the fire, where was an iron gas tube pierced with holes inclining upwards at an angle of 45°. Through this the gas passed, and served to light the fire, formed of coke or a mixture of coke and anthracite, after which the gas was partially turned down, but still served to keep the fire cheerful. Another and cheaper form of stove, was made entirely of cast iron. The cost in fuel was about the same, or rather less than that of an ordinary coal fire. The last speaker had said it would be impossible to supply sufficient gas for general heating purposes, but with this arrangement only a small quantity was required, about 12 cubic feet the first hour, and six or seven per hour afterwards, for a room half the size of that hall. Coke was rather a drug with the gas companies, and this would enable them to get rid of it, so that he had no doubt they would be glad to take it up.

Mr. Mitchell said the discussion seemed to have wandered into all sorts of subjects except the one specially brought before them, which was the causes of London fog and the means of getting rid of it. He hoped before the discussion closed, a little more light would be thrown upon these important questions.

A Member asked the cost of Dr. Siemens's grate, which he had inspected and was much pleased with. The ordinary asbestos gas fire he considered a mistake.

Mr. Bamber, in reply, said that the cost in cast iron, was 25s.; in copper, about two guineas.

Mr. Tracey, having protested against the Society being made an advertising medium, said, according to his experience, London fogs were no more dense than when he first remembered them. Again, London smoke was anything but an unmitigated evil, for it greatly neutralised the noxious effluvia arising from our present system of drainage. After a heavy shower the air in London was purer than in the neighbourhood of a country house, where the smell of the drains was always very prominent at such times.

Mr. G. M. Shore, after complimenting Dr. Carpenter on his paper, read a letter he had received from Mr. Deacon, engineer, of Cardiff, praising a furnace of his (Mr. Shore's) invention, a model of which was on the table. By means of this apparatus, the principle of which was a down draught and hollow fire bars, he warmed his entire house and a large conservatory with a fire-place 13½ inches wide and 16 inches long.

Thorough ventilation without draught was easily obtained, and it could be adapted to coal mines, and prevent the sacrifice of human life.

Dr. Carpenter, in reply, said the discussion had been so discursive, that it was impossible to deal with the whole of it, and it was the less necessary to do so, as many of the points taken up were not strictly within the scope of the paper. The observations of Mr. Symons were very pertinent, and he agreed with him that the extension of the metropolis had reduced the amount of evaporation within the area. But the fogs which arise in connection with the moisture of the earth were not those which the meeting was convened to consider, as they were found everywhere. Great objections had been made to the proposal to put a tax on fire-places, as he had foreseen, and the appointment of a Royal Commission had also been objected to, but he still adhered to his opinion, that a subject of this difficulty would be better dealt with, in the quiet air of a committee-room of the House of Commons, than by any kind of discussion likely to take place in such an assembly as the present, where everyone had ideas of his own, not always based on scientific principles. Reference had been made by one speaker to coldness of the ground as a cause of fog, but he believed the soil of London was very much warmer than that of any other part of the British Empire; and it was possible that, instead of coldness, warmth might have something to do with it. He quite agreed with Mr. Symons that people often referred to magnetic influences when they were ignorant of a subject; he confessed his own ignorance, and he believed the majority of investigators were in a like position, though some might know much more about it than himself. He had, therefore, taken the liberty of introducing the reference to the magnetic state of the atmosphere as a thing worthy of consideration by those who were studying the subject. He hoped the suggestions he had thrown out would be the means of leading some of his hearers to think a little more about the subject than they had done hitherto, and to press it on the Legislature. He knew, from personal experience, and the records he had kept for many years, that fogs of this character were much more extensive, heavy, and frequent than they were 20 years ago, and extended to a greater distance from London.

On the motion of the **Chairman**, seconded by **Mr. Liggins**, a vote of thanks to Dr. Carpenter was passed.

CANTOR LECTURES.

Prof. A. H. Church, M.A., F.C.S., delivered the third lecture of his course of Cantor Lectures, on "Some Points of Contact between the Scientific and Artistic Aspects of Pottery and Porcelain," on Monday, 6th inst., in which he dealt with stoneware, and other wares, glazed with salt.

THE PHOPOPHONE.

In accordance with the notice given in last week's *Journal*, a selection of the more important diagrams used by Professor Bell in his paper are now published.

Figs. 1 and 2 show the form of selenium cell used by Werner Siemens; Fig. 1 shows the zig-zag

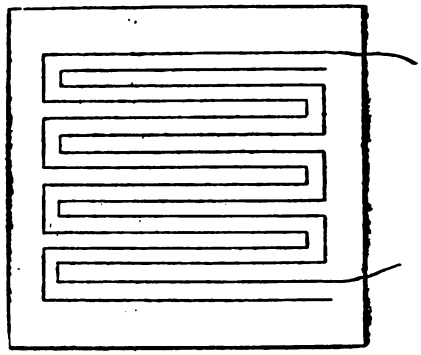


Fig. 1.

arrangement of the wires, and Fig. 2 the spi

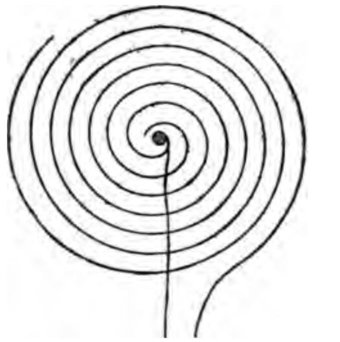


Fig. 2.

Fig. 3 is the apparatus employed in annea

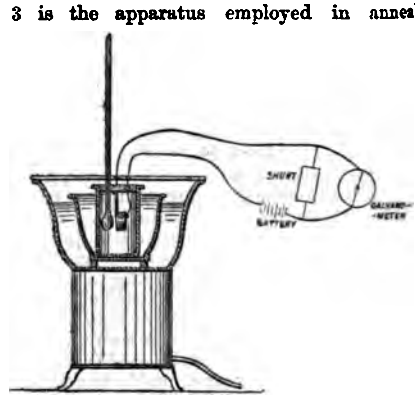


Fig. 3.

selenium cells by Professor Bell. The cell being plac

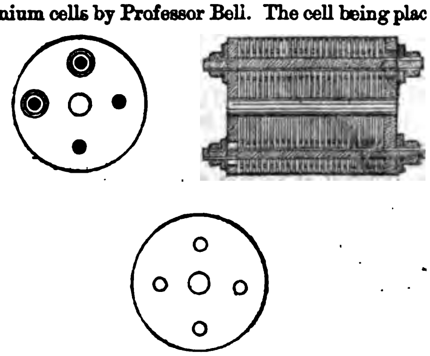


Fig. 4.

rior vessel, and surrounded by outer vessels con-
oil, a suitable source of heat is applied below
ole arrangement. Fig. 4 represents the latest
se'enium cell, in which alternate plates of brass
a are placed on a central spindle, and held by
ol's passing lengthways through the arrange-
The mica discs being slightly smaller than the
discs, annular spaces are left, which can be

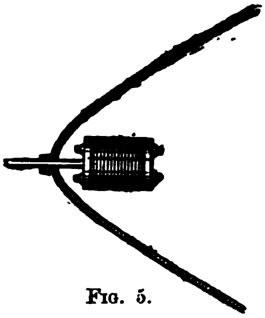


FIG. 5.

with selenium. Fig. 5 represents a cell
s description in the focus of a parabolic

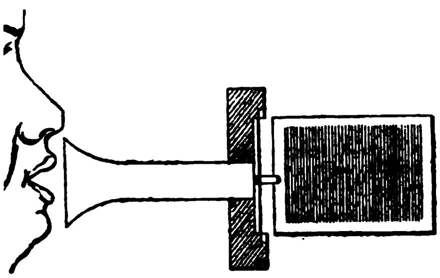


FIG. 6.

r. Fig. 6 shows one of the earlier forms
smitter employed by Professor Bell, in which
ing is caused to vibrate over a fixed grating,
impulses produced by the voice impinging on a
diaphragm, fixed to the movable grating. Fig.
ws the whole arrangement for sending and re-
g. A beam of light is reflected on a mirror,
t the back of which the sender speaks. The rays
d from this mirror pass through a lens, and are
d at the distant station by the parabolic reflector,
e selenium cell as its focus. Fig. 8 and 9 show

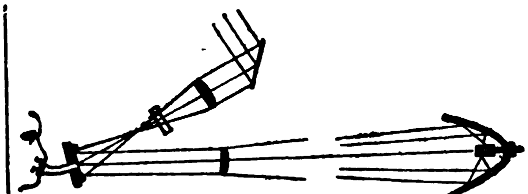


FIG. 7.

the arrangement adopted for producing a musical note

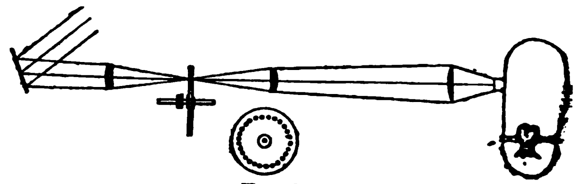


FIG. 8.

by rapid interruptions in the path of a beam of light.

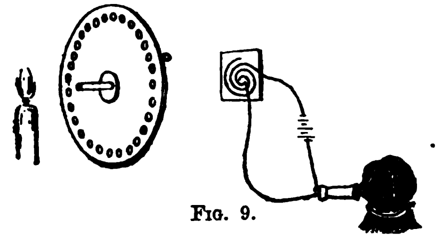


FIG. 9.

Fig. 10, together with the perspective view, Fig. 11,

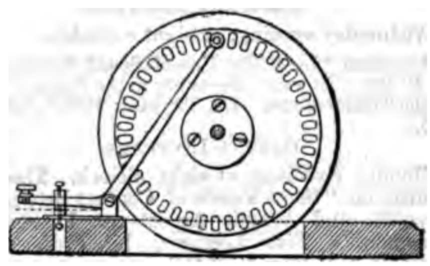


FIG. 10.

show the apparatus employed for this purpose. M is a

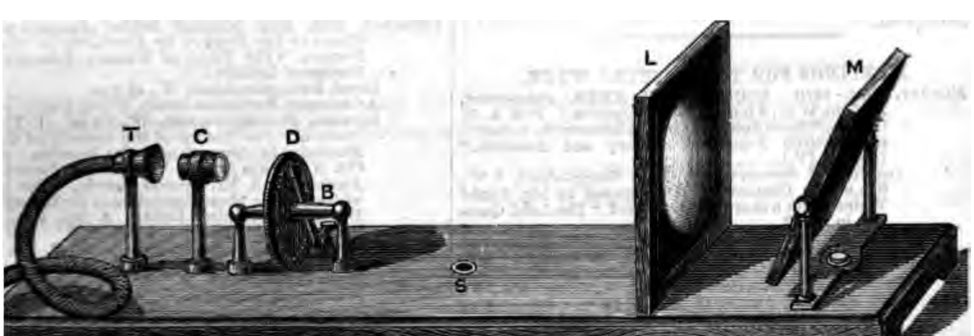


FIG. 11.

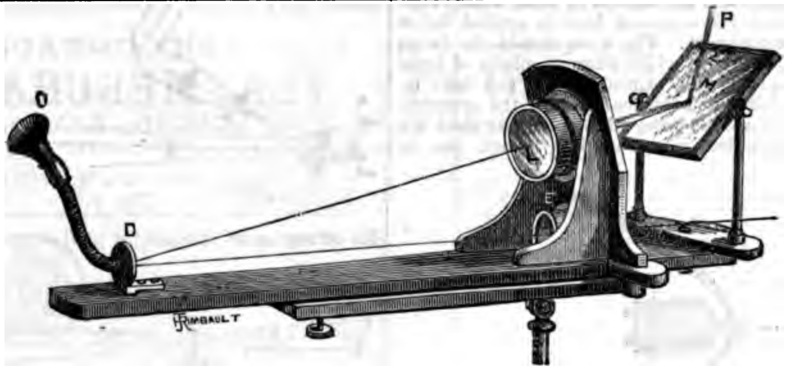


Fig. 12.

mirror for reflecting the light through the lens, L; D is the perforated disc; C is a lens, employed only when the apparatus is used to transmit signals, for which purpose the lever B becomes into play; T T is the hearing tube, at the mouth of which can be placed any substance to be tested for its power of producing sound under the impact of an interrupted beam. Fig. 12 shows the sending arrangement for the articulating telephone. M is the mirror; L the lens; D the flexible mirror or diaphragm; E the lens through which the light passes to the distant station; O is the mouthpiece of the speaking-tube. The two pieces of apparatus illustrated by the perspective views were exhibited by Professor Bell during his lecture. The blocks, by which the last two illustrations are reproduced, have been kindly lent by the editor of *Engineering*.

MEETINGS OF THE SOCIETY.

Ordinary Meeting.

Wednesday evening, at eight o'clock:—

December 15.—"The Use of Sound for Signals." By E. Price Edwards, Secretary to the Deputy-Master of the Trinity-house. Dr. Tyndall, F.R.S., will preside.

Cantor Lectures.

Monday Evenings, at eight o'clock. The First Course, on "Some Points of Contact between the Scientific and Artistic Aspects of Pottery and Porcelain." Five Lectures, by Prof. A. H. Church, M.A. Oxon., F.C.S.

Lecture IV.—December 13.

Soft paste porcelains, European and Oriental.

Lecture V.—December 20.

Hard paste porcelains, Chinese, Japanese, and European.

MEETINGS FOR THE ENSUING WEEK.

Monday, Dec. 13th ... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Prof. A. H. Church, "Some Points of Contact between the Scientific and Artistic Aspects of Pottery and Porcelain." (Lecture IV.)

Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. A Discussion will be opened by Mr. Daniel Watney with a short paper, entitled "The Land Question in 1880."

Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. Captain T. H. Holdich, "Geographical Results of the Afghan Campaign."

British Architects, 9, Conduit-street, W., 8 p.m. Mr. John E. Price and Mr. F. G. Hilton Price, "Remains of Roman Buildings at Brading, Isle of Wight."

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. W. St. Chad Boscawen, "The Kings of the Hittites—their Unburied Monuments and Civilisation."

Tuesday, Dec. 14th...Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. T. Seyrig, "The Different Modes of Erecting Iron Bridges."

Medical and Chirurgical, 53, Berners-street, street, W., 8½ p.m.

Photographic, 5A, Pall-mall East, S.W., 8 p.m.

Anthropological Institute, 4, St. Martin's-pla 8 p.m.

Zoological, 11, Hanover-square, W., 8½ p.m. Secretary, "Additions to the Society's during the month of November." 2. Pro Huxley, "The Application of the Laws of Ev the arrangement of the Vertebrata, and ticularly of the Mammalia." 3. Lieut.-Co Godwin-Austen, "The Animal of *Ferussacia g* Risso, from Mentone, concluding with a Cla of the above genus of Risso, and its Allies, by Neville" 4. Mr. Arthur G. Butler, "A Second of Lepidoptera made in Formosa, by Mr. H. E.

Royal Colonial, the Grosvenor Gallery Library, Bond-street, W., 8 p.m. Sir Richard Tem Statistics of the Indian Empire."

Royal Horticultural, South Kensington, S.W.,

Wednesday, Dec. 15th...**SOCIETY OF ARTS**, Jo Adelphi, W.C., 8 p.m. Mr. E. Price Edwa Use of Sound for Signals."

Meteorological, 25, Great George-street, S.W., Rev. T. A. Preston, "Report on the Ph Observations for 1880." 2. Mr. G. M. Whip Variations of Relative Humidity and The Dryness of the Air, with changes of Pressure at the Kew Observatory." 3. M Whipple, "The relative frequency of given the Barometer readings at the Kew Observat the ten years, 1870-79."

Geological, Burlington-house, W., 8 p.m. 1. Arthur Phillips, "The Constitution and Grits and Sandstones." 2. Prof, P. Marti "The Coralliferous Series of Sind, and its with the last Upheaval of Himalayas." Etheridge, "A new Species of *Trigonia* fro beck Beds of the Vale of Wardour." With the strata by the Rev. W. R. Andrews.

Bankers' Institute (in the Theatre of the Lond tion, Finsbury-circus, E.C.), 6 p.m. M William Barnett, "The effect of the Devel Banking Facilities upon the Circulation of the Including (for the purposes of this inquiry) term "Circulation," Bank Notes, Country B Cheques and Bills. Being the prize essay for t year.

Thursday, Dec. 16th...National Indian Associatio House of the Society of Arts), 8 p.m. S Temple, "The Effect of Western Educati Natives of India."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. M Darwin, "The Theory of the Growth of illustrated by observations on the Bramble. Col. H. Godwin Austen, "The Genus *Durge* Anatomy." 3. Mr. Francis Darwin, "The which Leaves place themselves at Right An Direction of Incident Light." 4. Mr. Wm "A Revision of the Genus *Vibrissea*."

Chemical, Burlington-house, W., 8 p.m. 1. Mr "The Estimation of Nitrogen by Combustion Nitro Compounds." 2. Dr. H. E. Armstro Napthaline Derivatives." 3. Dr. H. E. "Some Hydrocarbons Present in Resin Spiri

London Institution, Finsbury-circus, E.C., 7 Oliver J. Lodge, "The Relation between and Light."

Royal Historical, 22, Albemarle-street, W., 8 p

Numismatic, 4, St. Martin's-place, W., 7 p.m.

Philosophical Club, Willis's-rooms, St. Jam 6½ p.m.

Friday, Dec. 17th...Philological, University College, W

L OF THE SOCIETY OF ARTS.

No. 1,465. VOL. XXIX.

DAY, DECEMBER 17, 1880.

tions for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

ART-WORKMANSHIP.

I.

ciety's Medals in Gold, Silver, and id Certificates of Merit, will be awarded nens of Fine Art applied to Industry, in 1881, by manufacturers, designers, ien, or possessors of such works.

II.

ks may consist of illustrations of any or following processes, in combination or

ing in marble, stone, or wood.
oussé work in any metal.
mered work in iron, brass, or copper.
ing in ivory.
sing in bronze.
ing and engraving on metal—Niello work.
nel painting on copper or gold.
ting and modelling in pottery.
rative painting.
rs in wood (marquetry or buhl), ivory, or
eo cutting.
raving on glass.
l mosaics.
. engraving.
sinking.
s-blowing.
binding and leather work.
roidery.

III.

works the name of the designer and art- must be affixed. Further detailed rules ued later.

IV.

ranged with the Council of the Royal all, that the place of exhibition for the ntioned works will be at the Royal Albert e time for sending in the works will be hereafter.

V.

ove regulations are issued subject to on.

JUVENILE LECTURES.

The usual short course of lectures, adapted for a juvenile audience, will be given by Mr. G. J. Romanes, F.R.S., on "Animal Intelligence."

The dates for the lectures will be Wednesday, 29th December, and Wednesday, 5th January.

The lectures will commence at seven o'clock. As in former years, admission will be by ticket only, and no member can be admitted without a ticket. A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received, and the issue will then be discontinued. Subject to these conditions, each member is entitled to a ticket admitting two children and one adult. All members who require tickets should apply at once, as the greater part of the tickets are now disposed of.

CANTOR LECTURES.

The fourth lecture of the first course was delivered on Monday, 13th inst., by Prof. A. H. Church, M.A., F.C.S., on "Some Points of Contact between the Scientific and Artistic Aspects of Pottery and Porcelain." The lecturer dealt with soft paste porcelains, European and Oriental.

MUSICAL EDUCATION COMMITTEE.

A meeting of the Committee was held on Wednesday, 8th inst. Present—Sir Henry Cole, K.C.B., Vice-President of the Society (in the chair), Mr. Alan S. Cole, the Rev. Thomas Helmore, the Rev. Newton Price, Mr. James Thomson, and Mr. E. C. Tufnell, with Mr. H. T. Wood (secretary). A meeting was also held on Wednesday, 15th inst. Present—Sir Henry Cole (in the chair), Lord Alfred S. Churchill, Mr. Alan S. Cole, Rev. J. P. Faunthorpe, Mr. J. Thomson, and Mr. E. C. Tufnell, with Mr. H. T. Wood (secretary).

PRACTICAL EXAMINATIONS IN VOCAL AND INSTRUMENTAL MUSIC.

The next Examination in London will be held at the Society's House during the week commencing 10th of January, 1881.

The Examination will be held at three periods—morning, afternoon, and evening—viz., from 10 to 1, 2 to 5, and 7 to 10 o'clock on each day of Examination. Candidates may select either of these periods, but, the number of candidates in these Examinations being large, no special day or hour can be arranged for. The numbers

will therefore be arranged in order of application. The Examination for the Organ and Harmonium will be held in the evening only, and special arrangements will be made according to the number of applications. No alteration can possibly be made in this arrangement.

The fee is 10s. for the Honours (including both vocal and instrumental Examination), and 5s. for the First or Second Class (vocal or instrumental) Examination. If vocal as well as instrumental music, or two separate instruments, be taken by the same candidate for the First or Second Class Certificate, a fee of 7s. 6d. must be paid. Candidates should send the fee in stamps, or P.O.O. payable to H. T. Wood at the Head Office. As soon as the arrangements are completed, a numbered card will be forwarded, notifying the day and hour at which the candidate should attend, and the production of this card will admit to the Examination. The candidate will be known to the Examiner by this number only.

Candidates must also send a written certificate from some person qualified to give an opinion, to the effect that they have a reasonable chance of passing. Candidates who have already attended these examinations need not again comply with this regulation, but must state the fact.

At the conclusion of the Examination of candidates for the First or Second Class Certificates, the Examiner will record the result, with the marks in each section, on the back of the card, and hand the same to the candidate. The examination of the worked papers in the Honours Grade will necessitate some delay, but the result of this Examination will be conveyed to the candidates in due course.

The Certificates will be prepared as soon as possible after the Examinations, and can be had upon application at the House of the Society of Arts, on or after 1st March, 1881, on presentation of the numbered card. Certificates cannot be forwarded.

The Council will provide a grand piano, harmonium, and an organ. Any other instruments must be brought by the candidates. The services of an accompanyist will be obtained by the Society when candidates for singing are to be examined; candidates will, however, be permitted to bring their own accompanyist.

The Examination for the First or Second Grade Certificates will occupy about a quarter of an hour. Three hours and a half will be allowed for the Examination for Honours, during which time the candidates will have to undergo the *viva-voce* and the practical examination.

No Certificate will be granted to any candidate for Honours who does not obtain a First Class in the practical portion of the Examination, (vocal or instrumental. Candidates holdin(of such Certificates, obtained in a former need not again undergo this portion of the E nation, but should bring their Certificate fc Examiner's inspection. In such cases three and a quarter only will be allowed to the cand

The Examination of each candidate wi private; no one but the Examiner an(accompanyist being present, unless it be a ber of the Society of Arts' Committee. N of candidates will be published.

Particulars will be forwarded on applicati the Secretary, Society of Arts, John-s Adelphi. No names can be received after Dec., 1880.

PROCEEDINGS OF THE SOCIE

FIFTH ORDINARY MEETING.

Wednesday, December 15th, 1880; Prof. TYNDALL, LL.D., F.R.S., in the chair.

The following candidates were propose election as members of the Society:—

Andrew, Capt. C. W., 286, Kennington-park S.E.
Bayliss, Samuel, 5, Victoria-street, Westminster
Browne, Miss Annie Leigh, 58, Porchester-terra
Johore, The Maharaja of, Singapore.
Keymer, H. J. C., Marine-cottage, Gorlestoı Gorleston-docks, Great Yarmouth.
Reid, Arthur G., M.D., 24, Montague-street, W
Rigg, Arthur, 71, Warrington-crescent, Maida-vı
Taylor, George Noble, 3, Clarendon-place, Hyde-p
Wiseman, William Percival, Cumberland-house Pennard, Glastonbury.
Wragge, Clement Lindley, F.R.G.S., Farley Cheadle, Staffordshire, and Adelaide, South Au

The following candidates were balloted fc duly elected members of the Society:—

Begley, Mrs., 26, St. Peter's-square, Hammersm
Fall, Thomas, 9 and 10, Baker-street, Portman-ı
Fisher, Thomas, Church Entry, 75, Carter-lane,
Horsman, Godfrey Charles, 22, King-street. Po square, W.
Macauley, Lieut.-Colonel George William, 43, C road, W.
Stubs, Peter, Statham-lodge, Warrington.
Symmons, Edmund, Eagle-house, Hermon-hill, ford.
Walker, Robert, J.P., Kidwells park, Maidenhe
Waterhouse, Sebastian, 37, Catherine street, Liv and Windham Club, S.W.
Willans, William Henry, 23, Holland-park, W.

The paper read was on—

SIGNALLING BY MEANS OF SOU

By E. Price-Edwards.

In a recent trial it was argued that the mission of verbal sounds, *i.e.*, of the

ed by articulate speech, should properly be d as signalling, but in connection with ervations which I shall offer to you this , I prefer to accept the view of the learned on the other side, and to avail myself retort to the effect that, although my are in a sense transmitted to distant in this room, yet it would be an obvious lication of terms to say I was signalling e hearers. I think it necessary to make reliminary observation, because it is beyond urpose on this occasion to deal with methods of conveying oral sounds which been so marvellously developed during the w years. The value to mankind of these hing discoveries cannot yet be fully appre-l. We are evidently on the threshold of changes, as regards means of carrying es; the steam locomotive, the penny post, e telegraph system itself, are threatened by ssibility of other more simple and direct ls being brought into practical operation, by of the telephone, the phonograph, the hone, and last, but by no means least, the hone, of which so brilliant a description was y given in this room by its talented dis-r.

these are not the instruments which minister practice of signalling, in the sense in which e to place it before you.

gnal is defined as a sign which has been upon to give notice of some occurrence, nd, or warning, to a person or persons at a e. The necessity for such means of con-intimations is too obvious to be dwelt upon. hardly recall to you the system of signalling con fires, which was so extensively in use in days; nor need I remind you that those methods of ancient times have, in the process , been generally superseded by simpler and ffective means The splendid lighthouses coast, which convey guiding and warning s to the mariner; the coloured and other used for vessels at sea, and also for railway ses; flashing signals, employed for com-ating between H.M. ships at night, and for purposes, are all suggestive of ancient prac-although more elaborate and perfect, and to modern requirements.

gs, again, have for centuries been used as ms and signals for the conveyance of ges across intervening spaces. For military ses they continue to be used, and for service they have been so effectively utilised that now exists an international code, generally ed by all maritime nations, which permits rsation to be carried on between ships of all ries, the combinations of eighteen flags and pennants being the signals whereby messages between mariners who do not even under-each other's language.

semaphore was once much used for military lling, but it is now almost entirely employed nection with the railway service.

r storm warnings, drum and cone shapes are d at prominent points on the coast, to indi-the approach of bad weather.

d I may allude to the valuable invention of heliograph, or sun-flashing mirror, which red such conspicuous service in the late wars in Afghanistan and South Africa, by which signals can be flashed across an intervening space of from 50 to 100 miles.

Finally, signals of distress are made on board ship by the firing of rockets, and by flames on the deck.

It will be observed that the examples of signalling to which I have alluded are those which appeal to the sense of sight only. Signals, being intended for human purposes, are, of course, dependent upon human perceptions for their comprehension. Sight, as we have seen, is made available. I do not think any definite system has been developed by which signals can be transmitted through the medium of taste or touch; nor has science yet indi-cated any method of utilising the sense of smell for the conveyance of definite messages, although, in the vicinity of foul places and decomposing refuse, odoriferous signals are generally wafted abroad, plainly indicating the presence of germ-laden gases, and silently bidding us beware.

But the necessity for transmitting signals has been found to exist at times when sight is unavailing, and then the sense of hearing naturally suggested itself as the perception which should be appealed to.

Thus we arrive at the branch of the subject which I have ventured to bring under the notice of the members of the Society of Arts this evening; and I think it proper to say, that in preparing this paper, I have sought rather to make it a record of facts than anything like a speculative inquiry, and have encouraged myself to hope that my efforts may possibly be the means of bringing to bear upon the subject the scientific and mechanical in-telligence of many, in such an audience as this, and who may assist in the valuable work of develop-ing the means of making sound signals fulfil their purposes with accuracy and precision.

The effective employment of sound-signals appears to be chiefly dependent upon two factors, the facili-ties offered by the atmosphere as a vehicle of sound, and the human capacity for hearing and dis-tinguishing sounds of different characters. It will, perhaps, be convenient to regard first these two points, and afterwards to deal with the applica-tion of sound signalling for various purposes, and the different kinds of instruments used to produce the sounds.

It is hardly necessary, before such an audience as this, to attempt an explanation of the general laws governing the propagation of sound; and, in the presence of so eminent an authority as the learned professor who has so highly honoured my subject and myself by presiding this evening, to do so would show some temerity on my part. It is, nevertheless, necessary for me to put before you briefly various considerations relating to sound transmission, which have a direct bearing upon the matter in hand, but it is only proper for me to observe that in this respect I must borrow the thunder of your learned chairman, and place before you results obtained through his patient investiga-tion, judicial weighing of evidence amid conflicting theories, and unstinted expenditure of time and personal comfort.

The atmosphere is the vehicle for transmission of sound with which we are this evening concerned. Water is an excellent medium for sound travelling, and the possibilities which have from time to time

been suggested in regard to it, require only the attention of inventive genius to bring them within the range of practical reality and utility. But as at present the atmosphere is the only medium which is practically available for the transmission of sound signals, it becomes important to know whether some conditions are more favourable than others for its passage.

It is evident that there are various influences which may be supposed, in one way or another, to affect the transmission of sound. Wind has always been known as a most powerful agent in intercepting and even diverting it. Fog, snow, and rain, have also been regarded by many as serious obstructions, while it has long been popularly considered that a bright, warm, sunshiny day, with little or no wind, was exceptionally favourable for the travelling of sound. Those views, it may be said, have grown up as the result of general expectation rather than of scientific observation; but the development of signalling by means of sound has necessitated a more exact inquiry, than has hitherto been made, into the general subject of sound transmission, and the result has been that some of the old theories have been considerably shaken, if not overthrown, while new ones have been set up.

In the years 1873 and 1874, an investigation was carried out, at the instance of the Trinity House, with the object of obtaining some definite information as to the relative merits of sound-producing instruments, and also of ascertaining how the propagation of sound was affected by different meteorological phenomena. Professor Tyndall, as the scientific adviser of the Trinity House, conducted the investigation, aided by a Committee of the Elder Brethren, and some officers of the Corporation. The experiments were extended over a lengthened period, observations being made in all conditions of weather, and repeated over and over again, in order to eliminate error; and the information gained thereby is of the highest interest and importance.

The results are stated at length in the third edition of Dr. Tyndall's book on "Sound," but may be popularly summarised as follows:—That neither rain, hail, snow, or fog, has any sensible power to obstruct sound. From this it is most satisfactory to know that, at those times when a sound signal might especially be of service, the sound is not likely to be obstructed in its passage. That the real obstructors of sound are—first, the wind; and, secondly, what Dr. Tyndall has named acoustic clouds. These clouds have nothing to do with ordinary clouds, fogs, or haze, and may arise from air currents differently heated, or from air currents differently saturated with vapour, and they often exist on days when the atmosphere is in a very transparent condition. The obstruction is caused by the sound, intercepted by the acoustic clouds, being wasted by repeated reflections. In short, it is now established that a bright clear day is not necessarily the best for hearing distant sounds, and that on a day of dense fog it is more than probable that no obstruction is offered to the passage of sounds.

I must not omit to mention that experiments of an elaborate nature, in respect to the propagation of sound in the atmosphere, have also been made under the auspices of the United States Lighthouse Board, with results mainly corroborating those obtained in the Trinity House trials. In one respect, however, the late Professor Henry, who was at the time Chairman of the United States Lighthouse Board, differed from Dr. Tyndall, viz., in regard to the theory of acoustic clouds, and their resultant aerial echoes. Professor Henry's explanation of the obstruction of sound in clear weather, and the echoes, is founded upon the asserted existence of upper and lower currents of air, the tilting up of the sound wave, and the reflection of the sound from the surface of the sea, or the crests of the waves. From this last explanation, Professor Henry seems to have receded before his death. Into the details of this purely scientific controversy, it is not necessary to enter; but it may be stated, as a matter of fact, that the observations at the South Foreland, and the explanations given of them by Professor Tyndall, have been, one and all, illustrated and confirmed by strict experiment.

One other point may appropriately be alluded to here, viz.—as to the nature of the sound which is most readily propagated through the air, and which, therefore, is most effective for signalling purposes. It appears that what Mr. Alexander Beazeley (who very ably treated this subject of coast fog-signals some years ago) has termed "effective sound range," is made up of two factors, viz., intensity and pitch. It is tolerably well established that initial intensity is the first thing needful, and initial intensity depends upon the actual force employed in creating the sound waves. With suitable apparatus, and an effective application of very high power, there is little doubt that sounds of overpowering loudness may be produced. But the effective range of sound appears to be also controlled by its musical pitch. The short waves of a very shrill or high-pitched sound may appear extremely powerful and effective to observers in the immediate vicinity, but their energy seems to be quickly dissipated, and the sound fails to be appreciated effectively at a distance. Again, the long undulations of a very low-pitched sound do not apparently often reach great distances. It may be that this kind of movement is more readily acted upon by opposing influences, such as reflection or diversion. But, for practical purposes, it seems that the pitch best adapted for signalling lies about the middle of the scale of sound. With sound, as with light, there are wave motions above the highest pitch intelligible to the human ear, and below the lowest sound audible, and it may be, that the nearer sounds approach the limits of human apprehension, so they tend to become less appreciable. In addition to this, it has been found that the atmosphere exercises a selective influence, and, within certain limits, will, under some conditions, favour the transmission of the shorter waves, or high-pitched note; while, at another time, it may be found that the longer waves of a low-pitched note have the advantage.

Speaking generally, the range of sound seems to be attended with much uncertainty. It is popularly supposed that if a sound, at any one time, is heard ten or fifteen miles, it must necessarily be an exceedingly powerful sound. Now, this does not follow as a matter of course. The variability of the atmosphere will throw out any

ation made upon such an hypothesis. In the ments at South Foreland, in calm, clear er, one of the instruments was, on a certain heard at a distance of 16½ miles, but on r day, with apparently identical weather, me instrument was heard at only 2½ miles ce. Obviously, it is no satisfactory test of a signal that on one occasion it had a great —sounds comparatively small and weak have nes been audible at long distances—and, fore, I need not trouble you now with ces of this kind. The true test of a sound l appears to be that it shall, under all con- s of weather, be uniformly effective at a distance—say two miles.

ferred just now to what, perhaps, I may of as the sound spectrum, and to the limits nan capacity in regard to hearing sounds. with the development of signalling by means nd, I am not sure that the human capacity aring and distinguishing sounds of different has received the consideration which it merits. be granted that you have instruments capable ducing sounds of great power; let it also be d that the signals appear to be distinctive sy of comprehension, you will, I fear, still ery many people in the world incapable of g themselves of such signals, either by reason ole or partial deafness, or inability to appre- differences in sounds. Now, the question t naturally asserts itself, cannot something ne to assist the ear, or, at any rate, the per- n of sounds in the air. This seems to be the ementary side of the general question, to but little attention has been given. In re- to visibility, you have telescopes and binocular s, by means of which a distant object can be ht more plainly into view. But nothing of real value has been done to assist the ng. The old-fashioned ear-trumpet for deaf e is little, if at all, improved. Some years an effort was made in this direction by a eman from Glasgow, who devised what ermed a phonoscope. This instrument sted of a sort of metal helmet for the , with an opening like the bent cowl of a ney, which could be directed towards any required. This cowl was supposed to act as of ingatherer of sounds, which were con- l to the ears by two small tubes, each termi- g in a button, intended to go just inside the The faults of this apparatus were, first, its rousness, and, secondly, the remarkable way hich all the ordinary small noises around collected and magnified into large ones, , combined with other sounds hitherto ard, created a general uproar in the ears. object this gentleman had in view deserved er success than it obtained. He wished to the mariner in picking up and locating a it sound; and, although his apparatus acted ll that it picked up noises of all kinds, and what bewildered the sense of audition, yet I re to say that if any one were to accomplish sfully what this gentleman so perseveringly pted, a very great public benefit would be ht about. I do not mean to convey that is specially wanted is an improved ear- pet for deaf persons, but, rather, an instru- intended to aid people with fair hearing, or to render sounds, in some way, more easily perceptible. The late Professor Henry, of Washington, in carrying out his experiments, devised what he termed an artificial ear, by which the relative power of different sounds could be determined at short distances. This instrument consisted of an arrangement by which sand, on a stretched membrane, assumed certain definite forms, or was more or less agitated, in response to different sounds. As a phonometer, at short distances, this instrument appears to have been fairly effective, but it does not meet the want which appears to me to exist. With the growing use of sound for various purposes, there is scope for inventive genius to produce a phonoscope, which shall be capable of assisting the listening ear in a manner analogous to that by which a telescope aids the seeing eye.

The following is a general statement of the chief purposes for which sound signals of different kinds are in practical operation:—

1. *Railways.*—Whistles of locomotives, and explosives as fog signals.

2. *At Sea.*—For merchant ships, the international regulations for preventing collisions at sea prescribe, as a compulsory requirement, that in fog, mist, or falling snow, whether by day or night, the signals described as follows, shall be used:—

(*a.*) A steamship, under way, shall make, with her steam whistle, or other steam sound-signal, at intervals of not more than two minutes, a prolonged blast.

(*b.*) A sailing ship, under way, shall make, with her fog-horn, at intervals of not more than two minutes, when on the starboard tack, one blast; when on the port tack, two blasts in succession; and when with the wind abaft the beam, three blasts in succession.

(*c.*) A steamship and a sailing ship, when not under way, shall, at intervals of not more than two minutes, ring the bell.

And, as an optional proceeding, that a steamship, under way, may indicate her course to any other ship which she has in sight, by the following signals on her steam whistle, viz., one short blast to mean, "I am directing my course to starboard." Two short blasts to mean, "I am directing my course to port." Three short blasts to mean, "I am going full speed astern." A gun fired at intervals of about a minute is one of the authorised signals of distress at sea. In the Royal Navy the above regulations are also in force, but, in addition, Captain Colomb's system of sound-signalling is employed in fog, for the purpose of communicating between H.M. ships. Guns were formerly in use as fog signals, but are seldom if ever employed now.

3. *The Army.*—The only sound signals systematically employed appear to be those made with the bugle.

4. *Coast Fog Signals.*—By far the most important development of sound signals is in connection with the lighthouse and coast-marking service. The most powerful lights are unavailing at night if enshrouded with fog, and, by day, buoys, beacons, and other marks and signs of the sea, are then rendered useless. The necessity for sound signals to do duty at such times for the obscured lights and hidden sea-marks, has brought

about the development of a system of coast fog signals, in which development, so far as the English coast is concerned, the Corporation which I have the honour to serve, aided by your distinguished chairman, Mr. James N. Douglass, the Trinity House engineer, and others, have had a large share. The Commissioners for Lighthouses in Scotland and Ireland, aided by their respective engineers, have also taken vigorous measures for guarding their coasts with fog signals when necessary. It is proper, however, to observe that the lighthouse authorities in the United States took up the matter practically before it engaged much consideration in this country, owing to the east coast of America being in an exceptional degree liable to the visitation of fog, by which the coasting traffic was seriously inconvenienced; and the necessity arose for something to be done whereby the difficulty might be obviated. The ready genius of the country was not long in coming to conclusions, and although some kinds of sound signals, such as bells, gongs, &c., were employed in Europe, the Americans first brought into use Brobdignagian trumpets, whistles, &c., to which I shall refer in due course.

We will now pass on to consider the different kinds of instruments employed in connection with the various purposes to which I have referred.

Bells.—Bells, from the earliest times, have been employed to convey intimations by means of sound. Their chief uses in olden times have been summed up in the following:—

> "Laudo Deum verum, plebem voco, congrego clerum,
> Defunctos ploro, pestem fugo, festa decoro."

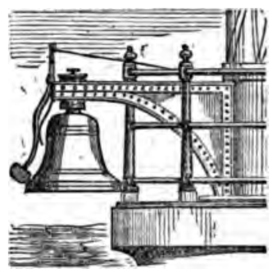
In these days churches have not a monopoly in regard to the use of bells. The town-crier, the muffin-seller, the railway-porter, and many others signalise themselves by the ringing of bells. With these, however, we are not concerned, unless we may express an opinion that in some of these cases it would be an addition to the public comfort if they were suppressed.

The present regulations for preventing collisions at sea require that, in fog, mist, or falling snow, "a steam-ship and a sailing-ship, when not under way, shall, at intervals of not more than two minutes, ring the bell." These regulations are international, but the Turkish Government have objected to the use of bells as fog signals on board Turkish vessels, on the ground that it is against their religion to use bells on board ship; and, therefore, in all cases where the regulations require a bell to be used, a drum will be substituted on board Turkish vessels.

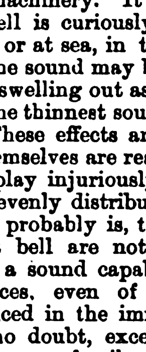
As warning signals, bells have been employed from a very early date. It is impossible to say when, or where, the first bell was put up to assist mariners; but we may quote the often-narrated tradition, handed down by an old writer, respecting the Bell Rock:—

> "By east of the Isle of May, twelve miles from all land, in the German Ocean, lyes a great hidden rock, called Inch Cape, very dangerous for navigators, because it overflowed every tide. It is reported in old times upon the saide rock there was a bell, fixed upon a tree or timber, which rang continually, being moved by the sea, giving notice to the saylers of the danger. This bell, or clocke, was put there and maintained by the Abbot of Aberbrothock; and, being taken down by a sea pirate, a yeare thereafter he perished upon the same rock, with ship and goodes, in the righteous judgment of God."

The story, it is true, is only supported by tradition, but it serves to show that the notion of marking a hidden danger by a sounding bell was certainly in existence—if not practically applied—at a very early period. We know it was practically applied at Poolbeg, in Ireland, in 1811, and at the Bell Rock, in Scotland, in 1812; and we also know that, up to the year 1860, bells were established, to be sounded in foggy weather, at many other lighthouses on the coasts of Great Britain and Ireland, and of France, the United States, and other countries, many of which continue to be sounded at the present day. These bells vary in weight



from 3 cwt. to 45 cwt., and are generally struck by means of clockwork. In no case does the bell itself move, the clapper, or clappers, alone being actuated by the machinery. It is well known that the sound of a bell is curiously fluctuating. In the open country or at sea, in the neighbourhood of church bells, the sound may be heard rising and falling, the peal swelling out as if close at hand—now fading into the thinnest sound, as if retreating far, far away. These effects are familiar to most people, and in themselves are really beautiful; but they come into play injuriously when the sound is wanted to be evenly distributed over a certain area. The truth probably is, that the vibrations from the largest bell are not of sufficient intensity to yield a sound capable of overcoming opposing influences, even of a slight nature. The sound produced in the immediate vicinity of the bell seems, no doubt, exceedingly powerful, the greatest energy of vibration being there exerted; but, at moderately long distances, this apparent energy is dissipated, and the bell ceases to be of use. It will be easily understood that little dependence can be placed upon bells as trustworthy sound signals for long distances. The effective sound range of the largest bell is at all times very doubtful; the wind may carry it to a distance even of 10 or 12 miles, but against the wind it may be inaudible at less than a quarter of a mile.



In one form the bell continues to be serviceably employed, viz., when fixed on the top of a large

with four hanging clappers around the out- f the bell, which alternately strike the bell buoy is moved from side to side by the of the waves. An incessant tolling is thus ip; and at night, or in foggy weather, the is most useful to mark the turning points at ntrances to important ports, and at other where the navigation is intricate, or to mark ed dangers. The number of bell buoys round ritish coast is considerable.

ngs.—The next kind of sound-producer we to notice is the gong. To most of us, pro- r, the gong has an inviting sound, that is, as for signalling purposes in our households. instrument has been appropriated for use on the light-vessels round the coasts, owing, bly, to its peculiar distinctive sound. The used in the Trinity House service are about et in diameter, of Chinese make, and cost

£4 each. They are struck with a stick a padded head, the strokes being very , and delivered in quick succession, so as ing up the gong into a vigorous state of tion. The sound is undoubtedly distinctive, erviceable at very short distances; but, like ound of a bell, is soon dissipated after leaving nmediate vicinity of the instrument. Passing ls may approach nearer to a lightship than rocky coast marked by a lighthouse; there- a sound with only a short range may often- s be of great service. In many lightships, ver, the gong as a fog-signal is now super- l by instruments of very much greater power.

ns and Explosive Signals.—Guns are used for us purposes in connection with signalling. minute gun at sea," indicates that some is in distress, and that assistance is required. is one of the authorised distress signals. On H.M. ships, guns have been employed for lling in foggy weather, in accordance with an ged code; and for salutes and other announce- s, they are used at military depôts and else- e. But their chief service has been as warning ls on headlands and dangerous points on a , to assist the mariner in foggy weather. The sity for distinctiveness in the use of sound ls, and the loudness of the report yielded by ischarge of cannon, led to the adoption of this of sound producer.

ere is no doubt that these gun signals have of the greatest value. Many and many a the warning gun has been heard by the dered seaman in time to enable him to alter urse, and probably save his vessel. Formerly uns were fired every fifteen minutes, but ly the interval has been altered to ten es. It would be difficult for two men to clean, load, and fire, for a lengthened period—say even twelve hours—with less intervals than ten minutes between each discharge.

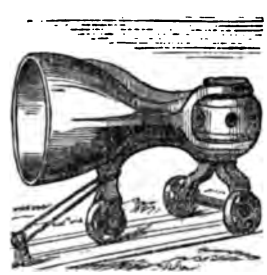
The piece of ordnance ordinarily employed was the old long 18-pounder, with a 3-lb. charge of powder; but in the Trinity House experiments at the South Foreland, it was found that a short gun, the 24-lb howitzer, gave a better sound than the long 18-pounder.

Professor Tyndall thus sums up his opinion of the gun as a fog signal:—

"The duration of the sound is so short, that, unless the observer is prepared beforehand, the sound, through lack of attention, rather than through its own powerlessness, is liable to be unheard. Its liability to be quenched by a local sound is so great, that it is sometimes obliterated by a puff of wind taking possession of the ears at the time of its arrival. Its liability to be quenched by an opposing wind, so as to be practically useless at a very short distance to windward, is very remarkable."

Professor Tyndall continues:—"Still, notwithstanding these drawbacks, I think the gun is entitled to rank as a first-class signal."

In 1874–76, some experiments were made at Woolwich Arsenal, with the view of reducing the labour of firing, so as to enable two men to fire at more frequent intervals, and also to produce, if possible, a more effective report than had been obtained by discharges from guns of ordinary pattern. Colonel Eardley Maitland, of the Royal Gun Factories, Woolwich Arsenal, devised a form of gun, breechloading, with six chambers, similar, in some respects, to a revolver, and with a parabolic mouthpiece fitted to the muzzle. The experiments gave promise that this fog signal gun would prove



a success, and ultimately it was conveyed to the North Stack, near Holyhead, in order that it might have a practical trial. To reach the station, it was necessary to cross very bad mountain roads, and the gun received a severe jolting, and probably jarring, for it broke down shortly after being used. No further attempt was subsequently made to repair the damaged gun, nor to manufacture another, owing to the attention of the Trinity House being then diverted to gun-cotton as an explosive sound-producer. It should also be mentioned that, in the trials at Woolwich, one experiment was devoted to testing the comparative advantages of the various kinds of service powder for noise-making purposes. The powders tested were—(1), F. G. (fine grain); (2), L. G. (large grain); (3), R. L. G. (rifle large grain); and (4), P. (pebble). In point of effectiveness in sound-producing, the result of the trial placed the powders exactly in the order in which I named

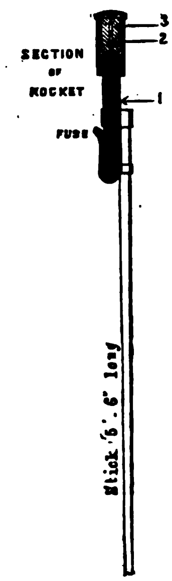
them; the fine grain, or most rapidly burning powder, giving indisputably the loudest sound; while the report of the slowly burning pebble powder was the weakest of all. The 80 and 100 ton guns, fired with charges of 300 and 400 lbs. of pebble powder, do not make anything like so terrible a noise as the enormous charge would lead one to expect. The sound seems to lack intensity; and, in comparison with the sharp smack of the detonation of gun-cotton, or of a much smaller charge of more rapidly burning powder, appears to be more of a prolonged and somewhat soft roar.

While upon the subject of guns, I must not omit to refer to the very ingenious invention of the gas gun by Mr. J. R. Wigham, of Dublin, the advantages claimed for which are that, where a supply of gas is available, the apparatus is very easily applied, and that the gun can be loaded and fired at a considerable distance from the point of explosion. The gun consists merely of a tube about 18 inches bore and 12 feet long, placed at the point where the signal is required to be made, and connected with a gas main or gas-holder, by iron piping. The gun is loaded with an explosive mixture of gas and atmospheric air, by turning on a cock simply, and is fired by a light applied by percussion or otherwise to the shore end of the tube, the explosion taking place at the mouth of the gun almost immediately. Mr. Wigham states that a gas gun may be fixed at the water's edge, or on a rock in the sea, at half a mile from the loading and firing station. The idea, which is certainly one of originality, was conceived by Mr. Wigham when he was engaged in connection with the application of gas to the lighthouse at Howth Bailey, and his experiments at that station have met with a very encouraging amount of success, but the system is not yet in practical operation as a fog signal.

In 1874, the Trinity House obtained the consent of the War Department to some experiments being made at the Royal Arsenal, with the object of ascertaining the value of the sound produced by the explosion of varying quantities of gun-cotton. The explosion of gun-cotton takes place so instantaneously, that an exceedingly sudden and sharp blow is given to the surrounding air, whereby a sound wave of great initial intensity is generated. A number of comparative trials were made at Woolwich and elsewhere, in which the superiority of gun-cotton over gunpowder was incontestably demonstrated. It was found that charges of gun-cotton, however fired, yielded reports louder at all ranges than equal charges of gunpowder; and further experiments proved that the detonation of half a-pound of gun-cotton gave a result at least equal to that produced by the firing of a 3-lb. charge of gunpowder. During these experiments, the various charges of gun-cotton had been merely suspended from a horizontal bar, or in the focus of a large parabolic reflector, and fired by means of electricity. To explode gun-cotton, it is necessary to employ a detonator, consisting of a small cylindrical copper case, resembling an elongated percussion cap, containing a certain quantity of fulminate of mercury. This detonator is inserted in the heart of the portion of gun-cotton to be exploded, and an attachment is then made with one wire, connected with a small electric machine, and with another attached to a conducting-plate embedded in the earth. On turning the handle of the macl current is induced sufficiently strong to gen spark at the connection of the wires with tl tonator, which, coming in contact with th minate of mercury, immediately explodes i instantaneously the explosion is communica the gun-cotton. If gun-cotton in a wet s used, it is necessary to have a small plug or of gun-cotton, into which the detonator is ins Four processes then take place, viz.:—1. G tion of electric spark. 2. Ignition of deto 3. Communication of explosion to dry prime Communication of explosion of dry primer wet portion. The entire operation is, ho perceptible to the human sense as one exp only. It will be readily understood that t charge gun-cotton in this way entailed some expenditure of time and trouble, and might inconvenient, if required to be repeated eve minutes for many hours during fog.

But it being clearly demonstrated that th plosion of gun-cotton gave a very effective s a project emanated from the Deputy-Mas the Trinity House (Admiral Sir Richard Coll K.C.B.), for making a rocket serviceable for ing a charge of gun-cotton up to a certain h and then causing it to explode. This projec with the aid of Mr. Brock, the well-known technist, and, subsequently, Mr. Mackie, an officers of the Woolwich Arsenal, after nun experiments, made a practical success; and at five stations on our coasts, we have rockets, either substituted for guns previously or established *de novo* for signalling in weather.

The following description of the rocket no



is given in the instructions issued to the fog attendants at Flamborough-head, where rockets have been in use since January, 1878. explosive used is a slight modification of cotton, called tonite, which is said to be ch than ordinary gun-cotton, and as effective fo ducing a loud report.

RIPTION OF ROCKETS.—For purposes of safety, ket is supplied, and is to be kept, in three parts,

The Rocket.—This is a case charged with the y rocket composition, and is intended merely to p the explosive charge to the required height, en to ignite the detonator which is to explode ite.

The Detonator.—This is an enlarged percussion-lled with fulminate. Its duty is to cause an on to take place in the heart of the tonite , whereby that charge is exploded. The de-r is ignited by the burning of the rocket sition.

The Tonite Cartridge.—This is the explosive produces the report, and which, with the de-r placed inside it, is to be fitted in the head of ket, when immediately required for use."

fitting together of the three parts can be plished in less than a minute; the rocket is ighted by applying an ordinary fusee to a of Bickford fuse, communicating with the composition. The whole operation occupies an two minutes. The cost of the rocket is 1s. 5d., whereas each discharge of the gun 2s.; and in foggy weather a rocket is sent up ten minutes. The advantages gained by the uction of the sound rocket are indisputable, particular more especially.

requently happens that the sound of a signal led to be spread over an arc of, say, 180 es to seaward, is obstructed, or deflected, by ening obstacles, so as to cause certain parts e arc to be immersed in sound shadow, into the sound penetrates with very feeble effect, ften not at all. This difficulty the rocket has ounted most successfully.

explosive charge is carried up to the height out 600 feet, and is there caused to explode e air. From the height at which the explo-takes place, the direct sound is sent down-s into places which would be completely en from the level at which a gun could be , and which would seldom be reached by the d of its discharge. At Flamborough Head, gun was placed on the extreme edge of the t, the cliffs being about 100 feet high. But in lington Bay, at a very short distance to the -westward, the gun was invisible at the sea on account of intervening faces and edges of liffs. A practical trial of the rocket *versus* the t this station clearly showed the value of the r. One man walked along the edge of the keeping the gun in sight, and several observers below on the rocks at the foot of the cliff, it low water at the time. It had been arranged upon intimation from the observers below, an above should signal to the people at the tation to fire, first a rocket, then a gun. At a er of a mile from the point, with a light wind st the sound, the first experiment was made. ocket gave a loud and sharp report, the gun a heavy thud. At half a mile the rocket was loud, the gun very faint. At 1¼ mile the t was loud and distinct, the gun heard only wo observers, and then only with the most ed attention. The fact of the explosion of ocket having been visible and audible on each ion, shows that it was clear of the obstructions quenched the sound of the gun, and hid its rge from sight. It should also be mentioned that the charge of the gun is 3 lbs. of powder, and that the explosive charge of the rocket consisted of 4 oz. of cotton powder.

The sound rocket is now in use at Flamborough Head, at Lundy Island, the Smalls Rock, in St. George's Channel, at Heligoland, and at the Tuskar Rock, on the south-east coast of Ireland. The system offers the means of placing an effective fog-signal at a rock lighthouse station, where limited space and accommodation would prevent the establishment of a gun, or signal requiring furnace and machinery.

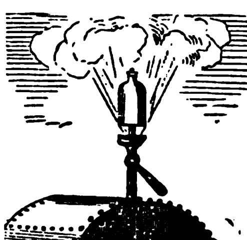
The development of explosive coast fog-signals has not gone beyond this point. Gun-cotton and cotton powder (or tonite) may be handled and stored with quite as much safety as gunpowder; in fact, they are really less dangerous; but it has not yet been shown that other explosive compounds, such as dynamite, lithofracteur, blasting gelatine, or any other nitroglycerine mixture, can be made practically serviceable. Some freeze at a temperature a little above 40° Fahr., and others do not lend themselves to manipulation, and to safe storing for lengthened periods. There is, however, every probability that further advances will be made.

One other form in which explosive signals are now used may here be mentioned. I have alluded to the gun fired at intervals of about a minute being the authorised signal of distress for ships at sea. Mr. Gardiner, of the Cotton Powder Company, has sent me particulars of a kind of signal which may be fired more easily, expeditiously, and effectively than the gun, thereby obviating loading every minute, an important consideration with a vessel in distress. This consists in a small charge of tonite made up into a sort of cartridge. When required to be used, one of these cartridges is dropped into a socket, and by pulling a lanyard attached to a friction tube, a small quantity of powder at the base of the signal is ignited, which blows the charge up into the air about 600 feet, where it explodes. At the moment of explosion some brilliant stars are also shot out, and thus the signal represents either a gun or a rocket, both distress signals. I am informed that many vessels have been supplied with these rocket signals, that their effectiveness is undoubted, and that the Board of Trade have sanctioned their use in lieu of either guns or rockets.

One further application of explosives requires attention, one probably more familiar than agreeable to most of us. I allude to the use of exploding signals on railway lines, to convey signals to engine-drivers and guards in foggy weather, and to do duty for the semaphores and coloured light signals when they are obscured. The system appears to be, that a signalman, furnished with a supply of detonators, places himself near to the signal-box or semaphore in connection with which he works, and uses the detonators to stop a train, if the line is blocked by the fixed signal. The detonator consists of a small quantity of coarse gunpowder, tightly bound up with three percussion caps; it is fixed on the rail with lead clamps, and is exploded by the wheel of the engine going over it. The system is said to be fairly effective; but it is probable that the British public generally would not endorse that opinion, for most people are fully aware of the annoying delays involved by the system, and certainly do not relish

the sudden explosions to which they are treated, while chafing under enforced detention in the train. There seems to be plenty of room for improvement; the system is cumbrous, and admittedly expensive; and we may well hope that a more effective and less objectionable method of signalling in fog may be devised for our railways.

Whistles.—The next instrument which claims our notice is the whistle. We will first regard it in connection with coast fog-signals. For this purpose, whistles, whether operated by steam or compressed air, do not appear to have found so much favour in this country as in the United States and Canada; indeed, with the exception of one station in the Clyde, where two small whistles, sounding different notes, are in operation, there are no fog-signal whistles on our coasts. In the United States they have been employed at various points since the year 1851. The first was set up by Mr. C. L. Daboll at Beaver Tail Point. In Canada, also, whistles have been in use for some time, the type adopted being that invented by



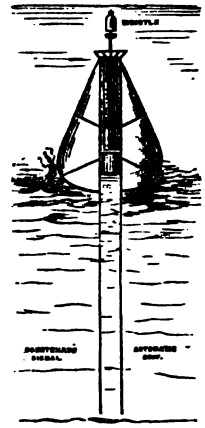
Mr. Robert Foulis, of St. John's, N.B., and known as the Vernon-Smith whistle; and in this country, Mr. W. H. Bailey, of Salford, Manchester, has given much attention to the manufacture of whistles suitable for sound signalling. Steam whistles are simple enough in their arrangements, requiring only a boiler for generating steam, and a simple mechanical arrangement for opening a valve for the periodic passage of the steam to sound the whistle.

For air whistles, it is necessary to have some motive power to compress air, and also some mechanical arrangement to regulate the admission of the compressed air to sound the whistle.

In the Trinity House experiments of 1873-4, it was shown that the sound of the most powerful whistles, whether blown with steam or air, was generally inferior to the sound yielded by other instruments, and, consequently, no steps have been taken to extend their use in this country. Various reports have been circulated as to the great distance at which whistles have been heard on the American and Canadian coasts, but no such results as those claimed were obtained in the very careful trials, made with both American and Canadian whistles, at the South Foreland, in 1873.

The sounding of a whistle is caused by the vibration of the column of air contained within the bell or dome, the vibration being set up by the impact of a current of steam, or air, at a high pressure. It is probable that the metal of the bell is likewise set in vibration, and gives to the sound its *timbre*, or quality. It is to be noted that the energy so excited expends its chief force in the immediate vicinity of its source, and may be, therefore, regarded as to some extent wasted. The sound of the whistle, moreover, is diffused equally on all sides. These characteristics, to some extent, explain the impotency of the sound to penetrate to great distances. Difference in pitch is obtained by altering the distance between the steam orifice and rim of the dome; when brought close to each other—say within half an-inch—the sound produced is very shrill, but it becomes deeper as the space between the rim and the steam or air orifice is increased.

The most recent adaptation of the whistle as a fog-signal is shown in an automatic signal buoy,



devised by Mr. J. M. Courtenay, of New York, by which a powerful whistle, fixed at the top of a buoy, is sounded automatically by the action of the sea. The apparatus consists of a buoy, 12 feet in diameter, with a tube 33 inches in diameter, and 32 feet in length, passing vertically through the centre, and descending below the bottom of the buoy to a depth of about 20 feet, the object of this length of tube being to reach a depth where the water is not subject to wave agitation. The bottom of the tube is open, and freely admits a column of water, which is maintained at a constant level, and is not affected by the external superficial wave motion. The buoy, however, to which the tube is fixed, moves with the surface undulations of the water, and, of course, carries the tube up and down with it, thus establishing a piston and cylinder movement, the column of water in the tube forming a piston, and the tube itself being a moving cylinder, the weight of the buoy and the tube exercising a considerable pressure. By means of the motive power so established, air, which is admitted by stop-valves into that part of the tube which is above the level of the water, is compressed and forced through a pipe $2\frac{1}{2}$ inches in diameter, communicating with and sounding the whistle at the top.

One of these buoys has been practically tried off the Goodwin Sands for some months, and has proved a success; two more are about to be placed at other points. On the coasts of the United States, France, and Germany, they have also been in successful operation for several months.

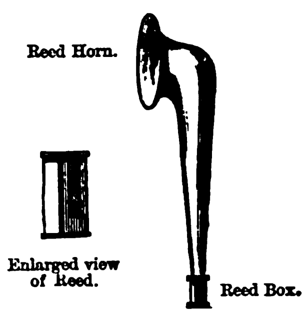
Whistles are supposed to be the best medium for making signals by sound on board steam-ships. The regulations which I have previously quoted,

he whistle for steamers; but it is neces-
t precaution should be taken to ensure
stles giving effective sounds. Many
stened to appear to me to be dismal
more especially when first sounded, for
y the condensed steam causes so much
the pipe, that when a sound signal is re-
be made in a hurry, only a rush of water
rough, without any effective sound.
ard the *Duke of Leinster* steam-ship, run-
ween Glasgow and Dublin, a novel form
le consisting of an organ pipe fitted on to
m-pipe, is said to give very superior
It is said that it does not get choked
nary whistles; and that the sound emitted
and resonant, without the shrill dis-
tone of many whistles. This instrument
ed by Messrs. Hannan and Buchanan, of
.

regard to the use of whistles on locomo-
ines, I have endeavoured to ascertain from
entlemen connected with railway engineer-
whom I beg to offer my best thanks for
rtesy in replying to my inquiries), whether
l of signal is the best for the purposes re-
and from the replies I gather that the
s, "Well, it might be better, but it just
" It does not appear that much is known by
engineers about the construction or shape of
and they seem to share the popular notion
shriller the sound the more effective it is.
I may here venture, in the general interests
avelling public, to utter a protest against
nsiderate and often unnecessary manner in
histles are sounded in the great railway
of this country, and London in particular.
it probable that this meeting will sympa-
th me when I say that, in these days of
susceptibility, and when so many thousands
le travel daily by rail, something ought to
by the railway authorities to abate the
of unnecessary whistling, and certainly to
n the sudden, shrill, ear-piercing screeches,
ake a strong man's nervous system tingle
nd which echo from roof, wall, and ground
berating shrieks. There is enough hubbub
tet at all stations, caused by the bustle of
rs, the arrival and departure of trains, the
g and banging of doors by porters; and
all this may be called exhilarating, yet the
of whistle screeches is too much to im-
on an enduring public. Drivers and stokers,
eir deadened perceptions, are probably not
f the real pain they often inflict on many
by their thoughtless use of the whistle.
l-signals are so necessary, let them be low,
nds, or a full-toned bell. Such as are used
motives in the United States would be a
lief.

Horns.—The next class of instruments to
reference should be made is the horn, or
t, in which air or steam pressure is em-
to set in vibration a metallic reed, or tongue,
ibration is communicated to air inside the
t, and also to the molecules of the metal of
he trumpet, or horn, is formed.

. L. Daboll, of the United States, to whom
e has been previously made, introduced,
an instrument of this kind to the notice of
ted States' Lighthouse Board, and a trial
was made at Beaver Tail Point, Rhode Island. This instrument was sounded with air condensed by two air pumps, worked by a horse, the compressed air being stored in a receiver, and the trumpet sounded at a pressure of about 40 lbs. to the square inch. Ultimately, Mr. Daboll employed Ericssen's caloric engine as the motive power for condensing the air, and an automatic arrangement for regulating the blasts, and in 1862, he introduced his improved signal to the notice of the Trinity House Corporation, who gave it a practical trial at Dungeness. The results being very satisfactory, the Corporation placed other instruments of the same kind at several places round the coast, and one was fitted up on board the Newarp light-ship. The experiments at South Foreland showed such instruments to be, under some conditions, very efficient, but they suffered from several disadvantages, which have led probably to their disuse of late years. I have alluded to the fact of some of the initial power being wasted in the case of whistles, by the metal of the dome, or bell, being set in vibration; this occurs to a greater extent with the huge brass trumpets which have



generally been associated with reeds. In a paper read before the Royal United Service Institution, in May, 1875, Admiral Sir Richard Collinson, in speaking of these horns, says that "there are objections to the trumpet being made of brass, and also to the necessity which exists for tuning the reed in unison with the fundamental note of the trumpet." Sir Richard goes on to remark, "the use of a trumpet consists chiefly in concentrating the sound into a beam, and thus causing it to be projected through the air with greater force in any required direction. The brass trumpet, no doubt, does this to a certain extent; but as the molecules of the metal are also set in vibration, sound waves appear to be generated from all parts of the external surface of the trumpet, so that, although a very loud sound may be produced in the immediate neighbourhood of the instrument, it is open to doubt whether that sound is transmitted with force to any great distance, its strength being, so to speak, dissipated in the space close to its source." The local noise occasioned by the vibration of the trumpet would be intolerable for any length of time. At the present time there are very few reed instruments with brass trumpets in operation, many of those originally established having been superseded by the siren, an instrument of which I shall speak presently. In connection with the development of reed horns very much is due to Professor F. H. Holmes, whose energy in connec-

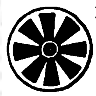
tion with the electric light is well known. Under his immediate superintendence and advice two reed horns, sounded directly by steam, were fitted on board two light-vessels sent out to China, and have worked very satisfactorily.

Reed horns are also used on board ship, chiefly sailing vessels, in compliance with the compulsory fog-signals, and the optional sound signals, in connection with the "rule of the road" at sea. The horns now exhibited are lent for this evening by Mr. Nathaniel J. Holmes, of Holmes' Marine Life Protection Association (Limited). They are said to be very effective, but in a seaway, with the vessel rolling heavily, the seaman has some difficulty in working the instruments. It is air pressure which sets this reed in vibration, and produces the sound. In some trials recently made by the German Admiralty, these horns held a commanding position.

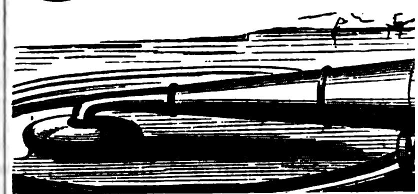
Recently, there has been brought into this country, from the United States, an apparatus known as Barker's marine safety signal, intended for use on board ship, to make sound-signals. The apparatus has many merits, one of which is its simplicity in working; a second is that every signal is sounded automatically when once set; and a third is that, with the horn attached, it gives a very good sound. Compressed air is employed at a pressure of 6 lb. to the square inch, and the sounding principle is a reed for the horn; but the inventor says, it can be equally well connected with the steamer's own whistle. The main object of the inventor appears to be to bring into use a short code of compass signals, by means of which vessels can indicate to one another their respective courses, the signal system consisting of eight combinations of long and short sounds. But it may be observed that the adoption of his code would make it necessary for the law to be altered, there being no permission or obligation to employ such signals in the rules now in force. And, again, the principle of long and short sounds which has been adopted, does not commend itself for service at a moment when there is no time to lose in deciphering the meaning of a sound signal from an approaching vessel. Captain Barker, however, has evidently had these considerations in his mind, for, in his descriptive pamphlet, he remarks that, though numbers of practical seamen consider the suggested code to be the simplest and best as yet brought forward, its adoption is by no means a *sine quâ non*, since the machine can, with equal facility, blow any code which may be decided on. Captain Barker would probably do well to adapt his machine to sound only those signals provided for in the regulations.

Sirens.—We now come to the instrument which has been authoritatively described as "beyond question the most powerful fog-signal which has hitherto been tried in England." In 1872, a Committee from the Trinity House, who went to the United States, witnessed the performance of an apparatus known as the siren, and patented by Messrs. Brown, of Progress Works, New York, and in the experiments at the South Foreland one of these instruments was sent over to be tried.

The instrument sent from America could be sounded either with steam or compressed air, made to pass through a fixed flat disc, fitted into the throat of a long trumpet, connected with the steam or air pipe. This disc has twelve radial slits, and behind it is a rotating disc, with twelve similar slits, th being effected by separate mechanism. then, the pressure of steam or air to be o disc fixed, and the other rotating; it will stood that the slits in each frequently in fact the twelve slits in one revoluti



Enlarged view of Siren Disc.



twelve times, and at each coincidence steam or air, at great pressure, escape into the trumpet. It is the rapid su these puffs which form the sound of the disc is rotated so as to make 2,400 rot minute; and as there are twelve coinci revolution, it follows that the numbe passing through in a minute would be = 28,800.

It can readily be understood that a surpassing power is thus generated, a vibrations produced are not taken up b iron trumpet, the sound issues from the a condensed beam of great intensity.

It is not of importance to record t distances at which the siren has been sound-range under different atmosphe ditions being so exceedingly variabl regard to its superiority over oth ments, we may say that, under met conditions unfavourable to the trans sound, the voice of the siren had a gre than that of any other sound-producer; when local noises—such as those of w ears, rattling of rigging, breaking wa surf, paddle-wheels, and the working of have to be contended with, "its densit pitch, and penetration, render it domi such noises after all other signal so succumbed." It is obvious that this overcome obstructions is the true te value of a sound signal, and it is prising that the experience of the the South Foreland should have led t tensive adoption of this form of fog sig coast of Great Britain. Since 1874, n 22 sirens have been placed at the most sa house stations on our coast, and 16 on b ships, moored in positions where a guidir of the greatest service to the passing r It should be added that, in the experime alone was used for sounding the s the instruments now in operation on are sounded with compressed air, the mo being caloric engines of greatly improv and construction, examples of which ar sive use at the Lizard, both for the elec and the fog signal. Steam is not a many lighthouse stations, owing to a fresh water; and the caloric engine, v

he siren disc, is regarded as safer and ıomical in working than a high-pressure ler, and is independent of water supply. ca, Canada, and some other countries, been employed with considerable success. wth Bailey, a gas-engine is employed as for compressing air for the siren now in there. This arrangement is due to Mr. m, of Dublin, and is said to work very .

Stevenson, of Edinburgh, have proposed Perkins engine should be employed as r for siren signals, but I am not aware suggestion has yet been carried out.

ɔption of the Siren as the most efficient ;nal for use in foggy weather, may be as an important epoch in the history of opment of the use of such signals. Imıts have been made by Mr. James N. , engineer to the Trinity House; and Mr. perintendent of the Trinity House works invented an improved arrangement by stead of flat discs being used, the siren conro concentric cylinders, with slits in both, the other, the outer one being fixed, and one revolving, with the smallest possible between them. The advantages of this ıent are, that the suddenness of letting king off the pressure is much increased, the successive blows upon the air are much sharper, and the sound intensity ɛed. It is also considered an improveıechanically, by somewhat lessening the ; Professor F. H. Holmes has sucin rendering the rotation of this siren r automatic, with perfect control of the nd consequent pitch, and an apparatus of ıd has not long since been fitted on board ht-ship at the Seven-stones.

ems probable that before long the siren will ught into more general use for maritime es. Already it has been introduced into the Navy, for which service Professor Holmes pplied three small-sized instruments. Sautter, Lemonnier, and Co., of Paris, lso produced a steam siren, which they n be used not only as a fog signal at e stations, but also for ships, and, in a form, for locomotives, in the place of the Mr. Wigham, of Dublin, has also deform of siren for steamships, driven by a bine, actuated by the current of steam or ich the instrument is sounded, the rate of being controlled and rendered uniform by governor.

Sautter, Lemonnier, and Co. have more introduced a double siren, in which two ving different numbers of orifices in their e cylinders, produce simultaneously two the trumpet, and by this means the power nstrument is more than doubled, and a ristic feature is given to the sound.

remains to offer a few general remarks he subject.

obvious that, with the increasing use of ignals, there is an increasing necessity for tiating them. Something must be done vent one from being mistaken for the in fact, it is necessary that every hould have its own characteristic. This essential element, as regards coast fog signals, has by no means been overlooked, and as each lighthouse is made to proclaim its own individuality, so every fog signal established on our coast has been made to particularly indicate itself by some distinguishing feature. One great reason why explosive reports, whether from guns or rockets, are made use of, is because their sound is so entirely different from that of the blast of a siren, a reed horn, or a whistle. Indeed, the three latter strongly resemble each other, and can only be distinguished by trained ears. It has also been found useless to attempt to get differential signals by means of pitch of the note alone. To employ a high note at one station, and a low note at another, would, in the present condition of the musical cultivation of mariners generally, be more likely to lead to confusion and disaster; although, as Sir Richard Collinson observed, in 1875, it might be possible to obtain an effective distinction by sounding a high and a low note in direct contrast. It has been frequently proposed to introduce long and short blasts; but here, again, experience has shown that many difficulties and risks would attend such an arrangement, and might result in conveying wrong information to the mariner, and lead him into danger. For real practical utility it has been found that, for the present, it is best to trust to the distinctions which may be obtained by varying the number of blasts, and the length of the silent interval. This is a system which is intelligible to the most ordinary understanding; and, accordingly, it is on this basis that the characteristics of sound signals are founded. By making the blasts to occur in groups, and varying the length of the intervals between the groups, on the same principle as that now applied to the new class of group-flashing lights, sixteen fundamental distinctions may readily be obtained, thus—commencing with an interval of half a minute:—

1 blast	every	½ minute	3 blasts	every	½ minute
,,	,,	1 ,,	,,	,,	1 ,,
,,	,,	2 minutes	,,	,,	2 minutes
,,	,,	3 ,,	,,	,,	3 ,,
2 blasts	,,	½ minute	4 blasts	,,	½ minute
,,	,,	1 ,,	,,	,,	1 ,,
,,	,,	2 minutes	,,	,,	2 minutes
,,	,,	3 ,,	,,	,,	3 ,,

The introduction of compulsory and optional sound signals in the new regulations for preventing collisions at sea, has naturally much extended the use of sound signals on board ship, and there can be no doubt that such signals should be entirely different from those made at fixed fog signal stations. It is said that already some difficulty has arisen in reference to the clause in the regulations, which enacts that in foggy weather a steamer shall sound a prolonged blast at intervals of not less than two minutes, the fact being that several coast fog sirens sound the blast every two minutes. Unless checked, this, perhaps, is a danger likely to go on increasing as ships' sound signals become more powerful and more generally used.

One point occurs to me, in connection with those gentlemen who give much time and trouble, and, probably, spend much money, in developing sound signals. I observe that they all take up some special code of signals, and then show how well their instrument is adapted for it. Now, if I might

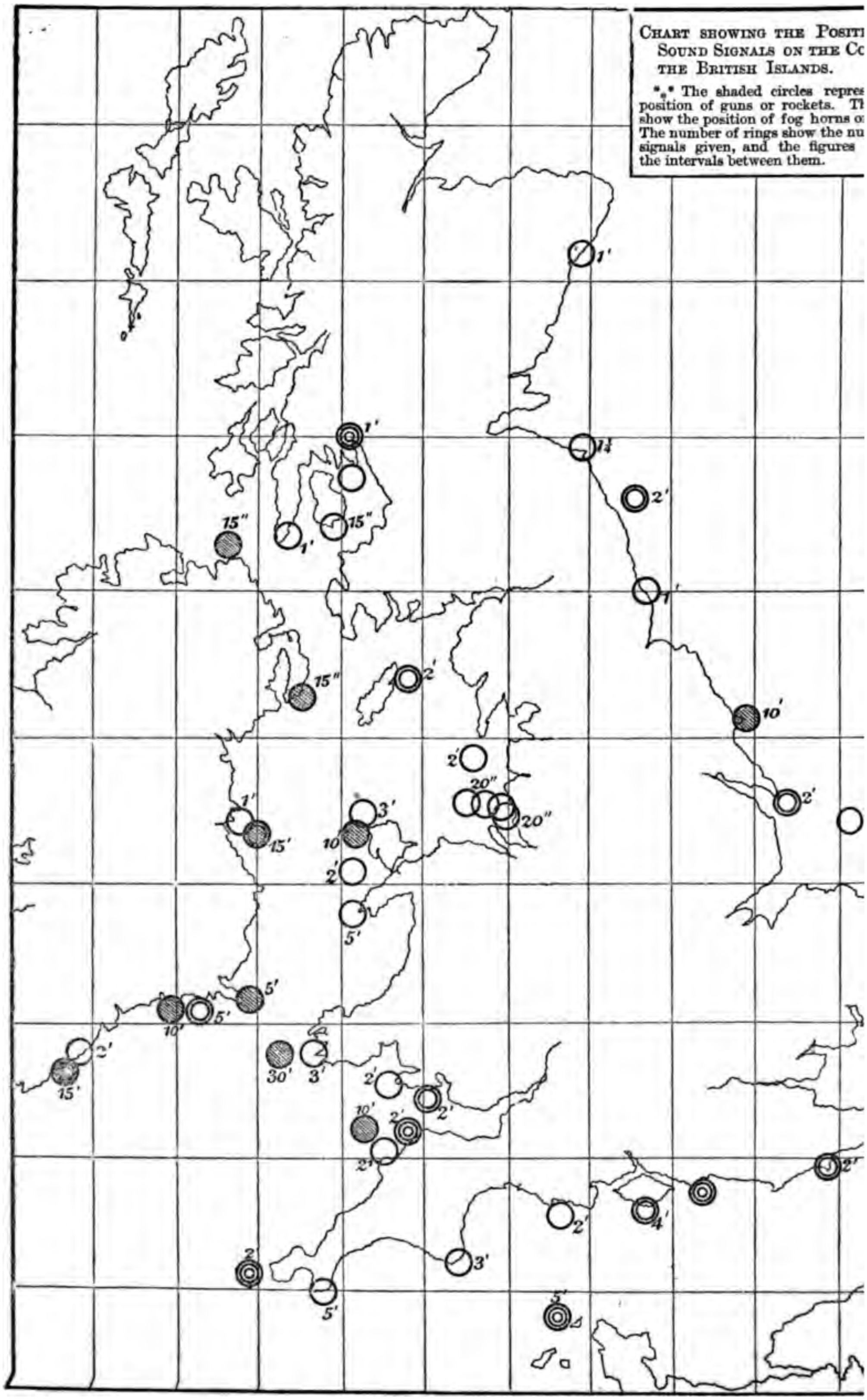


CHART SHOWING THE POSITI
SOUND SIGNALS ON THE CO
THE BRITISH ISLANDS.
** The shaded circles repres
position of guns or rockets. Th
show the position of fog horns o
The number of rings show the nu
signals given, and the figures
the intervals between them.
1'
1'
15"
15"
1'
1½
2'
1'
2'
15"
10'
2'
20"
20"
2'
1'
3'
15'
10
2'
5'
5'
10'
5'
2'
30'
3'
15'
2'
2'
10'
2'
2'
2'
2'
2'
4'
3'
2
5'

iece of advice to those gentlemen it would ; look at the law, and see what signals are d, then adapt your apparatus, whatever it , to making those signals. Don't require · to be altered to suit your instrument—that ng a real difficulty in the way; but make istrument suit the law as it now exists.

y remark it is not easy to see how the system g and short sounds can at present be brought atisfactory operation. Such distinctions are mely pretty and simple upon paper, but they ne a vastly different aspect in the mind of an ous and, perhaps, not over intelligent master ler, on board his vessel, say in the Downs, in k fog. All around he hears horns and whistles ng, and all he attempts to do is to keep clear se vessels which, by the sounds, appear to be t. Of what use, then, would be the comns of long and short sounds? Would he, bewildered state, care to try to distinguish n them? I venture to say he would have the time nor the inclination to do so; and not be forgotten that, in making provisions kind, it is not the skilled, clear-headed, educated, Royal Naval or merchant cap- have to consider, so much as the thousands ienced, weather-beaten master mariners, w well how to navigate their vessels under ircumstances, but whose minds are not for comprehending any system requiring and attentive observation, to which is n the necessity of finding out the meaning observation is made.

gards the present development of our ; signals, there is every reason for con- on. A glance at the map will show ensively they have been applied. This nch of coast marking has been brought very effective condition; no efforts have ared to cope with the seaman's greatest fog, and the remarks which I have had the to address to you indicate with what success forts have been attended. By the aid of ignals, the mariner is now enabled to con- is voyage with comparative safety, even is vessel is enshrouded with a thick pall im- ble by the keenest vision; and there is little hat those who have their business in the aters are ready gratefully to acknowledge the spirit which has prompted the develop- these signals, as well as the practical which they derive from them.

DISCUSSION.

Sir Richard Collinson, K.C.B. (Deputy-Master ity House), congratulated the Society on having Edwards to prepare this paper. Mr. Edwards ed his predecessor to America, and ever since had been, as his private secretary, more or less with all the experiments which had been was, therefore, eminently fitted to explain ment of this system. It was not as yet per- s had been said, they had still to bring to igh and low notes, with which experiments to be made. The recent rule of the road erchant steamers to make certain signals in r resembling to the fog signals on shore; l a difficulty, and it would be necessary to means of distinction. They had received munications on the subject of these fog s majority being in their favour; but when a man had successfully made his voyage, he did not think it necessary to say that he had been aided by the fog signal, whereas if he got on shore he was pretty sure to say he did not hear it. The air was such a subtle element that he hoped no seaman would ever put his faith in fog signals, but always have recourse to the lead. What he wished to impress on the seafaring people of the world was, that the fog signal was an auxiliary to navigation, but that it could not always be depended upon. Last year he received a very pleasant letter from Captain Schultz, commanding the Danish frigate *Sjalland*, dated from the Sound, Copenhagen, in which he said, "One, amongst thousands, I offer you my best thanks for what the Corporation has done for mariners in giving them fog horns, especially those at Dungeness and the South Stack light." He then went on to give the details of a voyage he made, starting from Portsmouth in a fog, which showed that he took all the care in sounding which a navigator ought. He concluded by saying, "The end of all this minute description is to show that by going back through the reckoning from our position at half-past seven in the morning, I found we heard the first sound of Dungeness fog-horn to windward at $7\frac{1}{2}$ miles, and lost the sound on the lee side at a distance of $2\frac{1}{10}$ miles." This was gratifying testimony to the value which these signals were to ships. Mariners were now becoming more accustomed to them, and no doubt they would enable vessels to shorten their voyages, but he would again repeat that they should not trust to sound alone.

Admiral Sir Erasmus Ommanney, C.B., F.R.S., said steam whistles and fog-horns had been introduced since he was on active service, but he was glad to learn they were now being reduced to a system, and becoming of such great service to seamen. Living near the Solent, he frequently heard the sound of these horns, and they often puzzled him in listening to them, for he had great difficulty at times in knowing in which direction the sound came; especially in calms. He would, therefore, join in the caution uttered by Sir Richard Collinson, not to trust to sound alone. His only experience of them at sea was as a passenger, but it was enough to show him that if not used with great care, and if there was too much similarity between them, they might lead to confusion and danger.

Captain Sir George Nares, K.C.B., F.R.S., remarked, that speaking, not as a sailor, but as one living for the present on land, it seemed very desirable, while giving the navigators the sound, to screen it from the shore; for they were now creating rather too powerful a sound for the neighbours of the lighthouses and signalling stations. The whole subject of sound signalling was brought about by the question of time. In the old days, they could trust to the lead, turn the vessel's head off shore, and as the depth increased, the mariner knew that he was taking care of himself and his ship, but nowadays they must make their 10 or 13 knots an hour, and, therefore, they must have siren signals to run up St. George's and the English Channel; indeed, these were called for to an increasing extent. Mr. Edwards said he could give 16 different sounds; and that was all very well; but every year the number of ships was increasing; and it was not only the fog signal on shore which sounded, but those from all the ships in the neighbourhood; so that something more than 16 signals was required. They wanted a diversity of sounds, and it had been stated that that was what the Trinity House were now aiming at. They would probably have to introduce different musical notes, and the time might come when every lighthouse would be playing a different tune.

Mr. James Douglass (Engineer to the Trinity House) said he could not add much to what had been said by Mr. Edwards. His part in the matter had been connected with the mechanical develop-

ment of the system. But with regard to Sir E. Ommanney's remark about the difficulty of determining the direction of the sound, he might say that he (Mr. Douglass) had been tested by the Chairman on that special point; he had been desired repeatedly to tell, blindfold, the direction of the sound, and he generally came within half a point of it. When that could be done, he thought you might depend pretty fairly on the direction of a fog signal. It was quite true that echoes sometimes interfered; and when hearing the secondary sound, you might be baffled as to which was the primary one. When you heard vessels sounding horns in all directions, and in addition to that, got echos from the sides of the vessels and the sails, you had a perfect Babel of sounds, and certainly a coast signal would require a distinct code of its own, which should be unmistakable. He had lately had the honour of discussing the matter with Professor Tyndall, and he then thought there was a possibility of a code being formed, perhaps by a combination of high and low sounds, succeeding each other in rapid succession, by which lighthouses and light vessels would give perfectly reliable signals. With respect to the siren, when the original form, with the disc, came into their hands, it was found to be the most efficient signal then known, but they were now able, by Mr. Slight's improved form with cylinder, to economise the quantity of air or steam used, so that the same result was obtained with one-third the quantity, and, consequently, with a like economy of motive power. There was, further, the application of the controlling power or governor, invented by Professor Holmes, so that they could now make an automatic siren, requiring none of the gearing used in the old form. This could be constructed so as to produce any given number of vibrations per second, and, consequently, either a high or low pitched tone.

Mr. Cooke said he had seen a bell buoy off the coast of Cornwall, and also in the Mersey, near Liverpool, and heard sailors speak in favour of them.

Dr. R. J. Mann having expressed his high appreciation of the able manner in which the subject had been treated, said there was one remark in the paper which was of particular interest to him, viz., the peculiar way in which differences of sound often failed to be distinguished even when the sound itself was distinctly heard. He was now realising that fact himself. He had fortunately a keen and excellent hearing, which had served him well all his life, but latterly he had been told that he was getting deaf. He was rather surprised at this, and had been observing carefully to find what was the real fact. He found this peculiarity, that while he could hear sounds quite distinctly, even light sounds in the street, yet when his wife spoke to him he did not hear what she said. This seemed to show that the peculiar deafness which came over a man in advancing years was due to a want of power to distinguish sounds, and he believed that was the form in which the deafness of advancing life primarily showed itself. Every syllable uttered by Mr. Edwards he had heard most distinctly, but it sometimes happened elsewhere that he failed to distinguish a good deal of what was said.

Mr. W. H. Preece was rather surprised that no reference had been made in the paper to the proposal which he knew had been put before the Trinity House by Sir William Thomson, that a system based on that of telegraphy should be applied to the lighthouses, so that they might speak in signals to the mariner in such a way, that wherever he might be he should know where he was. The map on the wall showed, that on entering the English Channel, there were three prominent points, the Lizard, the Start, and the Caskets; and it was perfectly clear that if each of those lighthouses were supplied with a siren, which should shout, in stentorian tones, "I am the Start," or "The Lizard," no one could possibly make a mistake, if he understood English, though a Russian or Danish sailor might still be
To make this system still more universal, Sir
Thomson proposed that every lighthouse should
its position in telegraphic language, which w
Instead of using common words, the name
spelled out in high and low tones, or by lo
short sounds, or by dots and dashes, but g
by long and short sounds, which were to th
graphist as clear and distinct as language.
telegraph station in the kingdom had it
particular name—Liverpool being Lv., Edi
Eh., and so on—and these codes were u
telegraphists in communicating with each
instead of the full names. These codes were c
of precisely the same signals as were used
Trinity House, to distinguish their different ligh
Eh. was composed of a short sound, followed a
interval by four other short sounds. By this
lighthouse might be flashing out its name all ni
in this telegraphic language. And not only could
by means of light, but it could do so by means o
They only need arrange the fog-horns, si
whistles, to repeat these signals after each ot
certain preconcerted way, so that whether by
night, in clear weather or fog, a mariner who h
learned this language, when he came within
a lighthouse, could not fail to know where
He knew there were serious objections
application of this method to lighthouse pu
the Elder Brethren were not likely, in a light
set aside a plan proposed by so high an authorit
William Thomson, and which had been pr
adopted at Belfast and at some place on the Cly
was, therefore, rather anxious to hear from Mr. I
what practical objections there were to the use of
which, in the ears of any one trained to tele
was as distinct as if each lighthouse were to st
boldly out of the water and cry out its own nam
regard to Mr. Courtney's automatic buoy, he h
to be in America some three or four years ago,
was being tried off Sandy Hook, and although
four or five miles from it, he heard a loud roar
wailing of a melancholy buffalo, which reach
great distance, much to the annoyance of the lo
men, but to the great comfort of mariners. Peop
not be selfish with regard to horns and the wh
locomotives, which were the language used by th
to communicate with the signalman. He could s
long experience, that the whistle was never use
it was required; the driver suffered from it as
anyone else, but it was essential to the safety of t
So with regard to fog-horns; they ought to re
a system which secured the lives of so many pe

Mr. S. J. Mackie wished, in the first place, to
credit which was due to Sir Richard Collinson of
been the first to apply explosive signals, for he
first who sent up an explosive signal rocket.
some years ago, he was making his first attemp
plosive signalling, he received the greatest
and kindness from Sir Richard Collinson;
wished to add a few words on the merit of gu
for signalling purposes. Guns required to be
order, and from the time taken in loading coul
fired oftener than once in ten minutes, where
cotton signals could be fired with certainty
minute; they could also be made, by using dou
single ones, to represent the dot and dash
telegraphic code. There was also this great adv
that gun cotton could be used for what he called "
ground signals." He preferred these for many
You could regulate the height according to the
you wanted the sound to travel; and in some
ments made at Folkestone it was found, wl
height above the pier was properly calculated, a
the weather was stormy, and the passengers we
ing on deck, it was distinctly heard by the stea
distance of five miles. There was also this adv

n the explosion was produced in the air alone : affect the stability of the ground or foundaie lighthouse, as might be the case with firing epeatedly. Gun-cotton could be used in all , not being affected by damp, and the sound ually in all directions; when fired from ie pier it was heard at Dover pier and at rhilst the lighthouse at the back screened the m the town.

ggins said he had been accustomed all his life ate the English and St. George's Channels, and ld mention one or two circumstances which the advantage of sound signals. The last bell saw was one which he remembered being ed by his late friend, Captain Peacock, and time he saw it, the sea was so calm that did not move, and, consequently, the bell did . That showed the advantage of having one of r's automatic buoys. On another occasion, the English Channel on a calm summer's day in boat from Calais, they almost ran upon the South l, and had only just time to stop the vessel and ern to prevent running on the beach. If there a loud siren blowing such a thing could not have d; but this was about 20 years ago, before such were introduced. On another occasion, he was in a dian mail-boat going down the Thames, and the Red Sand in a severe snowstorm. It would en prudent not to go beyond the Nore, but so were the directors to get the new ship round to mpton that they ran the risk. The sea was soon e ship, and they were in the greatest jeopardy; most remarkable thing occurred. They desired signal guns, and they had two nine-pounders ck. He himself saw the red-hot poker put to the hole, but neither he nor his friend by his side the sound of the gun. Whether the severe weather lysed their sense of hearing, or the snow prevented hearing the sound, he could not say. Happily were seen by a smack, and were soon got out of ger. There were many difficulties in the way of pting Sir William Thomson's suggestion; it was often y difficult to see the glimmer of a light at all, and r all, the sheet-anchor of the mariner in time of nger was the lead.

The Chairman having complimented Mr. Edwards his paper, said the perspicuity with which he had ated the subject was only a prolongation of the arness, intelligence, and tact which he showed when was at his (the Chairman's) side, day after day, ring those memorable experiments which the Elder thren had instituted at the South Foreland. The causes ich obstructed sound in the atmosphere were mainly . The wind, in the first instance; and secondly, ections from what he had called acoustic clouds. fessor Stokes's explanation of the influence of the d, which had long been a perplexity to scientific men, this. Supposing an explosion to occur, the wave ad away on all sides, so that it might be conceived little distance as forming an arch over the earth's ace. For the sake of simplicity, we may take a t portion of that wave near the surface, and consider raight and vertical; it would move on horizon-, supposing nothing occurred to make it move er at the top than the bottom, or *vice versa*. But take a case of the wind blowing in an opposite ion to the sound. The wind above was not so affected by the friction of the earth's surface as below, and, therefore, the wind above would quickly, and, consequently, the sound wave through it would be tilted backwards, and a slightly slanting direction. Now, the s of a sound wave was always at right to the face of the wave, and, therefore, ig to Professor Stokes — and it had been since — when the wave was thus tilted backwards by the wind, it gradually ascended, and passed over the head of the observer instead of coming to his ears. The acoustic clouds had been sufficiently described by Mr. Edwards, who, with himself, had made some remarkable observations upon them. They could be imitated. That room was now filled with acoustic clouds. From each mouth issued a column of warm air, and in passing from one portion of air to another of different temperature, or differently saturated, a certain portion of the sound wave was always reflected, and when this occurred extremely often, the sound was entirely wasted in these echoes which occured in the air. Hence there might be invisible acoustic clouds, which behaved towards waves of sound as an ordinary cloud did towards waves of light. Various observations had been made upon the sound sent back from these invisible clouds, and he well remembered, one perfectly clear day, the surprise Mr. Edwards experienced when he heard the trumpet above them sending forth its powerful notes, and those notes coming back from the air in front of them. They seemed to come from the wide expanse of ocean, for there was nothing apparently to yield an echo. With regard to the experiments with gun-cotton, Mr. Edwards had mentioned the cause of its efficacy, which was this. If you pushed your hand through the air there was a tendency to produce a wave, but no sound was audible, because the air was so easily moved that there was none of that condensation and rarefaction behind, which was necessary to form a sound-wave; the air slipped away in front, and closed in behind as you moved your hand. Hence the importance of imparting a sharp shock to the air, in order that it might not thus exercise its mobility. This was what gun-cotton did, and that was the advantage of using gun-cotton, or the cotton powder to which Mr. Mackie had referred. In these matters, he believed a most important step had been justly referred to the Deputy-Master of Trinity House, the use of a rocket to carry a mass of gun-cotton 800 ft. or 900 ft. into the air, where it exploded. You could in that way get the sound into alcoves and bays, which were entirely shut off from a signal fired on the ground. If he dared speak further on the subject, he must say that it was pleasant to him to think of the days he spent beside that distinguished Arctic navigator, who was the inventor of this gun-cotton rocket. The manner in which he held on to those laborious experiments at the South Foreland, always at hand, commanding the vessel, moving her about, making observations with the sextant, he should never forget, for a better or nobler fellow labourer he never had. The subject Mr. Preece had brought forward had already occupied the attention of the Elder Brethren, but in dealing with sound it was not really so easy as one might be led to suppose, and he believed his remarks were chiefly addressed to light. But, no doubt, in the investigations which were about being made, no trouble or labour would be spared to get to the bottom of the question of differentiating one sound from another, and, if possible, arriving at the ideal state of things when a signal station should by means of its sound tell its name. That was the ideal to aim at, and the man who aimed at the sky, as Chesterfield said, would, probably, reach higher than the one who only threatens a tree. So, by aiming at the ideal Mr. Preece had put before them, the Elder Brethren might attain a degree of perfection, which otherwise they might not accomplish.

Mr. Edwards, in reply, said he would only refer to Mr. Preece's remarks. Mr. Preece said that every man who could speak English would be able to read the long and short sounds or lights signalled at sea; but he should have added—if he knew the Morse alphabet, which was itself a difficult thing to learn. He, as a distinguished telegraphist, of course had it at his fingers' ends, but it would not be so easy, say, to the master of a collier, who had not very much intelligence.

He knew how to navigate his vessel, but if he were put to analysing these sounds, he would be saying to his mate, "Bill, was that a long or a short one?" and, if he had not a watch, was he to fetch a clock from the cabin, and calculate how long a flash lasted, whether it was half a minute, or a quarter, or ten seconds. It was not reasonable to suppose that a captain of a collier, and many other men of even less mental calibre, could appreciate what Mr. Preece thought so easy.

The Chairman then proposed a vote of thanks to Mr. Edwards, which was carried unanimously.

CORRESPONDENCE.

PREVENTION OF FOG AND SMOKE.

It is with much satisfaction that I observe that Dr. Alfred Carpenter is to read a paper on this important subject before the Society on the 8th of December. At the Great Exhibition of 1862, Mr. George Devey, architect, and I, had a joint exhibit in connection with the subject. Since that time I have had occasional letters thereon in the pages of the *Journal*, and also in the *Times* newspaper, and it seems to me desirable to present your readers with a brief review of this matter as a preparation for the discussion which will follow the reading of Dr. Carpenter's paper.

A summary of the facts connected with this smoke question will be useful. There are about 550,000 houses in London furnished with about 5,000,000 chimneys. Of these chimneys, in winter, probably about 2,000,000 are daily vomiting visible smoke into our atmosphere. The calculation is, that this smoke by its effect on house paint, furniture, works of art, and body linen, costs the inhabitants of London £2,000,000 sterling a year. There are about 6,000,000 tons of coal consumed annually in London, of which it is calculated that about one-tenth part escapes as smoke, that is, unutilised carbon, the estimated value of which loss is £600,000 a year. The density of London smoke fogs arises from the presence of moisture in the air, which moisture is partly occasioned by the damp clay of the London basin, but chiefly by the large volume of river water meeting the sea water at a different temperature, and hence condensation of watery vapour takes place in the valley of the Thames, but particularly at the mouth of the river, and hence our great smoke fogs chiefly occur when the current of air comes from the east.

Paris not being in the proximity of large masses of water enjoys a comparatively dry and clear atmosphere. Our geographical and geological position cannot, of course, be altered, but we can do much, so far as the smoke nuisance is concerned, to amend our unhappy condition. Beyond the 2,000,000 house chimneys which in winter pollute our atmosphere, we have the chimneys of several thousand factories. With regard to the smoke produced by these factories, including bakeries, and I may add the chimneys of the kitchens of the West-end club-houses, the remedy is quite within the scope of the Smoke Nuisance Acts passed by Parliament. All that is required, is that these Acts be somewhat extended, and the machinery for carrying them into execution be simplified and rendered more peremptory.

At present, the police only can lodge complaints, and the practice is to give two warnings previous to issuing a summons before the magistrate, while the average fine inflicted does not exceed 30s. Were any two householders in the neighbourhood permitted to inform, and were the average fine raised to £5, of which informers should receive one half, a few weeks could suffice to extinguish all factory smoke from London, because it is perfectly well known that by careful stoking, or by properly constructed furnaces, or by the use of smokeless fuel, such smoke can be abolished, and that to the pecuniary advantage of the manufacturer.

With regard to the abolition of the smoke proceeding from the two million household chimneys in operation in winter, the remedy is very much more difficult, but the smoke of ordinary fire-places could be abated or abolished by any of the following plans:—

1. By aggregating, say, every five hundred chimneys in one tall chimney, and then by a descending shower of water washing the soot into the sewer there to act as a deodoriser and disinfectant.

This method was proposed by myself and Mr. George Devey, by an exhibit at the Great Exhibition of 1862, but I readily abandon the plan as an interference with the freedom of street architecture, &c.

2. By the use of properly constructed grates—that is grates composed almost entirely of fire clay, with ornamental metal fronts—a great economy of fuel and more powerful combustion is obtained. Grates with perpendiculars bars are said to be better than those with horizontal bars. If grates were all fitted with blowers, to be used on first lighting fires, much smoke would be prevented, as it is on first lighting, or mending fires, that most of the smoke is produced. Dr. Arnott's grate with a closed bottom, where the fire is lighted at the top and burns downwards, produces a less smoky fire than an ordinary iron grate, but the appearance of the fire is dull, and the ventilation of the room imperfect. Dr. Siemens' coke and gas grate, as described in *Nature*, 11th November, is an excellent grate, as I can testify from examination. It produces no smoke, and heats a room 7,200 cubic feet at a cost of 4½d. for nine hours, notwithstanding that probably three-fourths of the heat produced is lost in the chimney.

3. By the use of coal-gas it is well known that cooking can be beneficially and economically managed in large establishments; but under the management of ordinary cooks, gas is an expensive cooking power. Were cooking by gas universal, as in summer kitchen fires only are in operation in our houses, the four months of the London season might be enjoyed in a perfectly smokeless atmosphere. Gas, as a heating power, can be economically used, provided the entire heat produced by its combustion is utilised, because, although gas, as compared with coal, cost for cost, is much inferior to the latter; yet, as three-fourths of the heat produced ascends the chimney, gas, under the above conditions, becomes cheaper than coal. If the demand for gas, for cooking and heating purposes, became much extended, the price of gas could be reduced, and also the price of coke, and thus the gas and coke fire might be cheaply produced.

4. By the exclusive use of anthracite and other smokeless coals, the smoke nuisance of London could be entirely abolished. It is stated that in Wales there are fields of smokeless coal, calculated at ten thousand million tons, equivalent to more than fifteen hundred years of our present London consumption of coal. This coal is perfectly adapted for all furnaces, and can be easily burned in all stoves and fire-clay grates, or in iron grates with blowers. Its freedom from sulphur is a further advantage, and in South Wales it is the usual fuel, both of cottages and towns, and where it is used there is no smoke. It is also used in New York and other towns of the Eastern States, and New York has a brilliant atmosphere, even in winter.

5. Lastly, I draw attention to the American method of warming houses, and as in America, the mercury often falls to zero, it is evident that the best heating apparatus becomes necessary to life. The American

l is to heat the entire house from a furnace in the nt. The furnace is placed in a small chamber, ih the external air is freely admitted; which air, ng heated by contact with the external surface of re, ascends through pipes to the top of the house, ing openings in these pipes into each chamber; ening being closed at pleasure. Thus it may be at is laid on like gas or water, to be used as re-

By this method the heat produced is, or might irely utilised, while a continual current of fresh, air is admitted to the house. The hot chamber be constructed as a Turkish bath, and thus ly heat the entire house, but act as a most ous and hygienic domestic arrangement. By g a house from a central fire, the dust and black of our ordinary fireplaces are avoided, and the s are saved the labour of carrying scuttles of coal. merican furnaces are chiefly of iron, and the roduced is sometimes excessive. I should re- nd fire-clay stoves, with fire-clay brick flues, as Turkish baths. As this central fire has a furnace t, any kind of coal can be used with smokeless

he smoke produced by our factories could be at olished, and that with advantage to the manu- rs.

y the general use of gas, coke, and smokeless he smoke of London could be abolished, and thus ,000 saved to the inhabitants.

y cooking with gas and coke, and warming our by a central furnace, the smoke of London could lished.

'o secure these advantages even in part, the public, er with surveyors, architects, builders, and grate acturers, should act in unison with the producer , coke, and coals. But as the smoke nuisance of n is a rapidly increasing evil, Government may one nd it necessary to place the regulation of our tic hearths, and our gas, coke, and coal supplies, some central and paternal government.

GEORGE WYLD, M.D.

reat Cumberland-place,
th November, 1880.

is letter was in type before the reading of Dr. ater's paper, but was not published owing to want ce.]

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time did not allow me to join in the discussion r. Carpenter's paper I now send you a few ks upon it. I have been writing about tic fire-places for seventeen years past, at a great f time and money. If I have not succeeded ing a recognised public service, it is because e not received the assistance from the press which t to have had. They have been willing enough ive my money for advertisements, but have not the trouble to read and understand my books. w that the subject has come prominently forward, y hope that it will not be left till a thoroughly ing reform has been commenced.

ll first of all allude to the extraordinary and daring sitions of carrying off smoke by some thousands y chimney shafts, with immense furnaces burning them, supplied with the air and smoke from our s. Those who have brought forward such pro- ons can have no adequate conception of the ous cost, the overwhelming difficulties, and of the nty that, after all, the smoke would not be con- l, unless it was done in every separate fire-place.

w, as regards gas. I do not wish to prejudge, or r anything that may prevent a fair consideration . Siemens's contrivance, but I must tell you that, than twenty-five years ago, my firm entered y on the manufacture of gas-stoves, and that we oned it entirely, in consequence of its bringing stantly into collision with our customers. The cost of gas was too great, and, in a large number of instances, the products of combustion did not pass effectually away by the chimney. These remarks do not apply to the use of gas for casual purposes, especially those of cookery.

Now, as regards anthracite coal. It is used in Wales, not from choice, but from necessity. It is nearer people's doors, and is very cheap. In using it here, we are asked to use a blower to make the fire burn cheerfully. By this you carry off the air of your room with great velocity, which air must be replaced from your doors or windows, or you will have a sluggish draught in the chimney itself, with a return of offensive products of combustion. If you propose to mix anthracite coal and bituminous coal in equal proportions, you must have machinery for breaking the coal into small pieces, and for mixing the two. You must also be prepared to pay the expenses of scientifically breaking and mixing. If this is not considered to afford a satisfactory solution, we must ask what may be done if we continue to use bituminous fuel. Dr. Arnott pointed out, many years ago, the proper way to use bituminous fuel was by introducing the fresh fuel below the fire instead of at top. A little consideration and observation will show us the utility of this. It is when fresh fuel is thrown on the top of a fire that a quantity of vapour, darkened by particles of carbon, escapes from the fire, and is what we call smoke. If, however, we introduce the fresh fuel below the fire, or burn a body of coal from the top downwards, like a torch or a candle, the vapour passes away invisibly through the hot stratum of coal, and the particles of carbon are consumed. Dr. Arnott's grate had certain defects, through which it never became popular. The objections were the sunk ashpit, the use of machinery, and the heavy appearance of the grate. I have not the slightest hesitation in saying that these objections may be effectually overcome, and, as regards matters of design or taste, Mr. Ernest Turner has kindly consented to give his valuable assistance.

Notwithstanding the objections, the grate has been highly appreciated for a long number of years by highly accomplished men. Sir William Gull has used it, and recommends it to his patients. His own grates were used by his predecessor, Dr. Todd. Sir Roderick Murchison used it with great satisfaction, and Mr. Thomas Burgoyne, a well-known solicitor, changed in the course of ten years the whole of the grates in two large houses in Stratford-place, and told me emphatically, that he had been repaid the cost of the grates by the saving of fuel, over and over again.

Now, as regards the kitchen department, we waste, undoubtedly, an enormous deal of fuel. We produce a large quantity of smoke, and we so fill our flues with soot that they require clearing every week. The matter, however, may be dealt with in a highly satisfactory manner, but only by following Count Rumford's advice, and avoiding the open fire altogether for nearly all the purposes of cooking. For the whole of the hot water required by a household we ought to use a closed fire and burn anthracite coal. This should enable us to have a warm bath at midnight without disturbing servants. For our ovens, used for baking, or ventilated when used for roasting, we should have a separate fire, never to be lighted except when absolutely required, and in this we may burn anthracite coal or coke. For our hot plate we may use gas or anthracite coal. In using gas, we must take care to provide means to carry off the fumes by the kitchen chimney, and in using anthracite coal we require a closed fire-place, and that the hot plate should be made in one piece, with only a round cover over the fire, so that we may get the full benefit of the laws of the conduction of heat, having no heated flame to depend upon.

I am sure that these arrangements can, with a little ingenuity, be combined in the basement of nearly all modern houses. It may be, however, that for very

small households an American stove, to burn coke or anthracite coal, and a little gas boiler, would meet all requirements, and give no smoke.

Now, can we reconcile our servants to this system? I believe we can, but we can only do it by training them. We must provide them somewhere in the basement, with an economical open fire-place, at which they can warm their fingers, and do little domestic offices; such as toasting bread, cooking a chop, boiling a kettle, &c., instead of using the gas hot-plate.

I have now given an outline of the way in which the smoke question, so far as domestic fires are concerned, may be effectually dealt with. We may not get rid of smoke entirely, but if we get rid of nineteen-twentieths, as we may unquestionally do, we shall do as much as can be expected, as long as we retain the use of open fires and bituminous fuel.

I will only add that I hope, after the close of this winter's discussion, to have the privilege of bringing forward the whole subject of the domestic uses of fuel, when I trust I may be able to deal with it more elaborately than at the present time.

Frederick Edwards, Jun.

Great Marlborough-street.

At the discussion on the prevention of smoke fogs in the metropolis, and in large towns generally, it was my intention not only to trace out, as far as possible, the true source of the evil, but to point out the limits within which the remedies obtainable would appear to lie. As it happened, however, I had only time enough to give a brief outline of the first topic, the claims of other speakers to a hearing not admitting of more than a general reference to the second branch of my intended communication to the Society. I wish now to supply that unadvoidable omission.

As the report of the paper and speeches delivered at the meeting will show, I succeeded in proving, from the official returns of the annual consumption of coal in London, and from the admitted data of gas manufacture, that the quantity of water generated by the combustion of raw coal amounts daily to a mass equivalent to a rainfall of one-eighth of an inch over an area of 20 square miles; or, if a smaller surface be taken, of a quarter of an inch over an area of 10 square miles. This aqueous mass, converted into vapour in certain favourable states of the atmosphere as to pressure and temperature, &c., would obviously occupy an enormous volume, and would be sufficient to spread over the whole of London, if limited in height as Dr. Carpenter demonstrated it to be.

I alluded incidentally to the shameful waste of ammonia accompanying the general waste of fuel, due to imperfect combustion in our ordinary fire-grates. This waste will be best appreciated when I state that, assuming the gluten of wheat—the nourishing element in it to be on an average 26 per cent. of its weight and the nitrogen 15 per cent. of the gluten, 13 lbs. per ton of coal being the ammonia, the production of 8,000,000 of tons would be equivalent to 5,200,000 quarters of wheat, taking 60 lbs. as the weight of a bushel. In first quality wheat the gluten is 35 per cent., which would give even a larger number of quarters. This conclusion might seem to be irrelevant to the main question of the fog nuisance, but if we reflect that this important element of fertility is the invariable concomitant of the general waste of fuel, due to imperfect combustion, and withal, an element injurious to the respiratory organs, and to the mucus membrane, we shall perceive that it strengthens, under its double aspect, the claim of the public to a reformed system of heating their dwellings.

At this point it is proper to observe that the most perfect combustion of bitumenous coal could do no more than remove the hydro-carbons in their gross and unconsumed state, the ammonia and the aqueous vapour in the purer fog still remaining unsubdued. If the hot products of combustion were to be cond through the tubes of a tubular boiler full of cold w they would be condensed, heating the water in passage, while the resulting liquid would pass i receiver, thus collecting the ammonia present. If boiler were to be constructed with two pipes, municating with a cistern of water at the top of house, the warm water would ascend, while cold was descending, until the temperatur both vessels should be the same. The hot water be conducted from the cistern above by pipes, to the upper apartments of the house, and used for and other domestic purposes. This, it is needless t applies to only the better class of houses, manufact &c. The working classes, lodgers, and others wo restricted to the use of coke, or of anthracite co stoves suitable to their combustion. In this cas coke must be manufactured somewhere, in or London, or near the pit's mouth, and then the qu naturally arises—"What would be done wit gas?" The answer to this is simple—"The application of the gas would be to heating purpo all kinds, by means which should ensure perfect bustion, and utilise the heat of the products o combustion." It is implied that the ammonia wo collected in the cooking process yielding the gas. iron works the gas could be used in cementing th ore preparatory to charging the blast furnace simple calculation determining the weight of ir reduced by the gas due to a ton of coals would s most readers. I only indicate this process element of economy.

I now come to an application of both coke and a cite coal to the production of carbonic oxide gas, could be conveyed by pipes, like the present lig gas, to every fire-grate in London. I advocat with much hesitation, well knowing the fear prejudices which I have to encounter. It is medical men, of great authority, that carbonic o a deadly poison, but, so is carburetted hydroge certain proportion to air of respiration, besides be explosive and dangerous to life as gunpowde common with nitrogen, both gases asphyxiate; w as a true poison, or by deoxidising the blood, equally fatal. But is not carbonic oxide, as carbonic acid, at present evolved in great qua passing, with nitrogen, sulphurous acid, an phuretted hydrogen, up our chimneys, especially red hot grate full of coals?

More than this, it is to be noted that carboni would not be consumed like the present lighting the midst of our apartments, by burners sus above our heads, and free, in case of escape, to with the air which we breathe. It would be bu as it is at present—in the grate, with a current heated products of combustion passing up the ch and even if escaping unburned, being specifically than air, it would ascend. With anything like a constructed and well-ordered apparatus, the gas led indirectly to the grate from without the walls, dents to life would not be more frequent than at pr from the incautious use of carburetted hydrogen g burners. The heat given out by a grate filled pumice stones, or balls of fire-clay, submitted to burning carbonic oxide, would be very intense, gi out, too, a bright light, and could be regulated to an by the jets. There are two modes of generating gas from limestone or chalk, by passing its carbonic through red-hot coke or anthracite coal, or by pa steam through the same heated fuel. I prefer former, because when spent, the produce in lime be sold to advantage.

But there is a second application to which I i special attention. By slaking the quick-lime (abov if spent steam be used for the purpose) in cylin placed in large reservoirs of water, at least as heat would be evolved as was originally employ

the carbonic acid. The water so heated could eyed in well-fitted pipes to a great distance for ig houses, as well as for domestic purposes. The y of fuel thus attainable in the great city of n would be enormous.

object is to ventilate the above suggestions, in ope that their publication may lead to their nation by that large class of ingenious and cal minds habitually devoted to kindred objects, therefore competent judges of the merits of my m. I trust that I have succeeded in proving that thing more than complete combustion is required event fogs.

F. C. KNOWLES.

field, Ryde, 13th Dec., 1880.

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may interest some of the members of the Society rts to know that it is quite easy to burn a mixture ke and gas in an ordinary domestic grate, without to the expense of fitting Dr. Siemens's regenerarangement to it.

ve done so for some time, and first described my in a letter to the Fog and Smoke Committee, 27th October last. Dr. Siemens first described rangement in a letter to the *Times*, dated 2nd iber. A drawing and description of my grate is ed in the *Sanitary Record* of 15th December; but ay here that the whole thing consists in lining te with fire-brick, and introducing small gas jets upon the front of the coke, through perforations iron gas-pipe laid at the bottom of the grate in

ve fitted an "experimental gas meter," by and Co., to one of my grates, and carefully ed the coke supplied to it, and find that the cost as never reached one halfpenny per hour, which cost of burning a mixture of gas and coke in Dr. s's grate, as given by himself. I find the smokere pleasant, convenient, and economical, but o interest in any manufacture, or sale of any connected with it. I hope, for the sake of the here of London, that it may be extensively d, and any person who thinks of having it fitted own house, is quite welcome to call and see mine.

COSMO INNES, C.E.

ham-street, Adelphi.

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patent was granted in 1873 to the Rev. Thomas tencroft, rector of Morton, near Manchester, for improved method of warming dwelling-houses ther buildings, economising fuel, burning slack, ing the bulk of the refuse, improving draughts, ring smoky chimneys."

patent consisted in closing in the space between tom of the grate and the hearth by an iron k plate, or back of an ashes-pan, forming a r beneath the fire, to which a supply of air was nicated from within or without the room, usually e space beneath the floor, thus preventing dry from the room below, so ventilating it; this f air was controlled by a valve, which regulated bustion. In burning coal, a saving of 25 per s effected, while with careful stoking, 45 to 50 . was easily reached. With this stove, coke a better fire than coal, as an intense glow or a ing fire may be had as desired.

undreds of the grates were fitted in the neighof Manchester, and satisfactorily; but through t means to work the invention (which also hands of a sole manufacturer), the business t collapsed.

ention may be applied to most grates by an workman.

THOMAS WOLSTENCROFT.

house-square, E.C.,

ber 14th, 1880.

I was rather surprised to find an old popular error cropping up in Dr. Carpenter's interesting paper upon Fogs; and was the more surprised that it should occur there, because Dr. Carpenter has evidently made a careful study of the subject of fog. Near the bottom of the second column, on page 52, Dr. Carpenter observes, that the most curious effect of the fog "is the obliteration of sound, which prevents one from perceiving the approach of moving objects, until they are close upon you, and moving vehicles suddenly appear like ghosts upon the scene; a noise upon the top of a building is heard much more distinctly than one near the ground." He then goes on to remark, that where the fog was thickest, the sounds were most indistinct. Now, if there is one fact more certain than another about fog, I take it to be the fact that fog is rather a conductor of sound than an obstacle to it. This has been proved by the long-continued observations carried on by Dr. Tyndall on behalf of the Trinity House, and has been further verified by a series of experiments made by the same distinguished philosopher. It is now a received axiom that sound is not impeded by a homogeneous layer of air or fog, but that it is obstructed when it has to pass through layers of various density. It is also, I believe, accepted, that sounds are heard further in dense solid fog than they are in a clear day, when the air, though optically clear, is very likely to be acoustically impervious. It is curious that the error—for error it must be admitted to be—should be so deeply rooted. I have tried on one or two occasions, but in vain, to convince signalmen on a railway that they were able to hear as far in fog as on a clear day; but I have never succeeded in inducing them to believe me, or even to make careful observations after I had talked to them.

H. T. W.

[Since the above was written, the subject has been further elucidated by the paper read last Wednesday by Mr. Price Edwards, and by the remarks of the Chairman of the meeting, Dr. Tyndall.]

Now that strenuous exertions are being made to mitigate the evil of London smoke, it is but fair that some notice should be taken of the endeavours made more than two centuries ago, by a distinguished Englishman, with the same end in view. John Evelyn published, in 1661, his "Fumifugium, or the inconveniency of the Aer and Smoak of London dissipated," in which he proposed two presumed remedies. One was, the banishment of noxious trades (such as brewers, dyers, soap boilers, and lime burners) from London; and, the other, the encouragement of plantations. He particularly recommended the plantation of lime trees as an antidote to the evils of London smoke, and it is supposed that the trees in St. James's-park were planted there in consequence of this suggestion. In accounting for the origin of his book, Evelyn says, that while walking with Charles II. in Whitehall, his attention was attracted to the clouds of smoke that issued from chimneys close by Northumberland-house, and adds, that the king commanded him to draft a Bill for presentation to Parliament, by means of which the nuisance should be abated. The author subsequently conferred with the Attorney-General, but nothing came of the suggestion, in spite of its having been made by a king. "Fumifugium" was re-issued in 1772, when the editor referred in a preface to the smoke made by the York Buildings Waterworks; and, in 1822, an analysis of the tract appeared in the *Journal of Science, Literature, and the Arts* (vol. xii. p. 343).

X.

The following letter was addressed to Mr. E. Chadwick, C.B., Chairman of the meeting, on the 8th inst.:—

I regret that an engagement, already made, prevents my being present at the meeting of the Society

of Arts on the 8th inst., to hear the paper on smoke abatement in London. I may say that I am sure that the metropolitan gas companies would give cordial assistance in the matter, if from no higher than selfish reasons, because the employment of gas for the purposes of warming, ventilating, and cooking, as well as for motive power, would induce an increased consumption, the effect of which would be to add to our shareholders' profits, and, as under the existing sliding scale of price and dividend the companies are actually in partnership with the consumers, further reduction in the already low price of gas must needs follow.

The gas companies have, thus far, not had very much cause to thank the local authorities, whose object appears recently to have been to prevent the proper lighting of the streets, but you may take it from me that the use of coal gas is, at present, only in its infancy, and it not only can, but will be applied with as much success towards the object you have now in view, as the companies have already shown it to be capable of for the mere purposes of illumination.

J. Phillips, Secretary.

The Gas Light and Coke Company,
Horseferry-road, Westminster, S.W.,
7th December, 1880."

HOUSE-DRAINAGE TESTS.

The system of testing drains by the use of peppermint or Mitcham oil, as used by the Boston Board of Health, as explained at page 16, and by Mr. Innes, as per page 45, is rather indefinite, I consider, for general use. In this case one has only the sense of smell to be guided by, whereas by the smoke test the more definite sense of sight is added to that of smell. The sulphur which I use to raise the smell is also a good disinfectant. Sometimes there are people, too, who have "no noses," and who refuse to believe the smelling evidence as to the drains, &c., leaking, but when the smoke is seen pouring out they cannot get over that evidence. The smoke test is also the most practical one to apply when laying new drains. In the smoke tests I speak of, the smoke is blown into the pipe by means of a fanner. I have used this mode regularly for some years back.

W. P. Buchan.

21, Renfrew-street, Glasgow, 4th Dec., 1880.

It seems to me a pity to waste a good, honest, anti-spasmodic, like oil of peppermint, down soil-pipes, reversing the adage of putting the beggar on the gentleman. Instead of using "an ounce of the Mitcham oil for each house, that costs 2s. 6d.," I utilise the remainder fluid drawn from my gas carburetter, which, though not "like the sweet south that breathes upon a bank of violets," as a detective, will knock oil of peppermint into a cocked hat.

P. Hinckes Bird.

1, Norfolk-square.

CROYDON BOURNE FLOW.

The following letter from Mr. Baldwin Latham, M.I.C.E., F.G.S., appeared in the *Daily Chronicle*. It refers to the underground river that rises at certain times after a period of considerable rainfall:—

"Under the head of 'Local News from Croydon,' I find it stated in your issue of to-day, that, in the course of a few days, the Croydon Bourne will rise in Marden-park. As the author of the prediction of the rise of the Bourne in Croydon, will you allow me to state that, although Marden-park is, traditionally, the place in which the Bourne rises, the Bourne recently predicted by me will not rise here, and it is very improbable that it will flow at all this year in Marden-park. The predicted Bourne will commence as a small Bourne, flow very much lower down the valley than Marden-park, or immediately below the 'Rose and Crown,' under Riddlesdown, and about 1,500 yards Kenley Railway Station, and will not comm flow until after December 11.

"These Bourne flows, which have for many c past troubled superstitious persons, have been upon to presage 'war, pestilence, and famin there are numbers of instances where a Bourne f accompanied great outbreaks of disease, as case in the great epidemic of fever in Croydon broke out in the latter end of the year 1852; Bourne flow was not the cause of this epidem the other hand, as a rule, the healthiest years a in which there is the largest quantity of wate in our subterranean reservoirs, but generally t ditions, antecedent to a great Bourne flow, ha favourable to the development of fever an diseases.

"This occasion will make the fifth year in have predicted the date and volume of these my Bourne flows, and up to the present time each pr has been verified, showing that the cause of these flows has been taken out of the region of conject placed within the range of scientific demonstra

"The predicted Bourne will commence to flo earlier period than usual, and, in consequence, i bable future volume cannot be predicted with c Present indications show that it will little exc which occurred in the spring of 1878. If there be a large rainfall between the present time and of February the predicted Bourne may develop large flow and break out in Marden-park, but should be the case I should be able to predict its ance even in that locality before it occurred, as one which broke out there in the early part of

I am, Sir, yours faithfully,

"Baldwin Latham.
"C.E., M.I.C.E., F.G.S., F.M.S.

"Westminster, S.W., November 30, 1880."

MEETINGS OF THE SOCIETY.

Cantor Lectures.

Monday Evenings, at eight o'clock. Th Course, on "Some Points of Contact betw Scientific and Artistic Aspects of Potte Porcelain." Five Lectures, by Prof. Church, M.A. Oxon., F.C.S.

Lecture V. and last.—December 20. Hard paste porcelains, Chinese, Japane European.

MEETINGS FOR THE ENSUING WEE

Monday, Dec. 20th ... SOCIETY OF ARTS, Jo Adelphi, W.C., 8 p.m. (Cantor Lectures.) P Church, "Some Points of Contact between the and Artistic Aspects of Pottery and P (Lecture V.)
Medical, 11, Chandos-street, W., 8½ p.m.
Victoria Institute, 7, Adelphi-terrace, W.C., 8 p.
London Institution, Finsbury-circus, E.C., 5 p. E. Ray Lankester, "Growth from the Egg."

Tuesday, Dec. 21st...Civil Engineers, 25, Great Geo Westminster, S.W. Annual General Meeting
Statistical, Somerset-house-terrace, Stran 7¾ p.m. Mr. R. Price Williams, "The Q the Reduction of the Present Postal Telegrap
Pathological, 53, Berners-street, Oxford-street, W

Wednesday, Dec. 22nd...Royal Society of Literatu Martin's-place, W.C., 8 p.m. Mr. Walter Birch, "Pictures from the Life of St. Guthlac, Century Roll in the British Museum."

Thursday, Dec. 23rd...London Institution, Finsbury-ci 7 p.m. Mr. W. R. S. Ralston, "A Story-telli
Civil and Mechanical Engineers, 7, Westminster- S.W., 7 p.m. Mr. A. Y. Walmsley, "The Pa and their Influence on Trade."

Friday, Dec. 24th ... Quekett Microscopical Club, College, W.C., 8 p.m.

L OF THE SOCIETY OF ARTS.

No. 1,466. VOL. XXIX.

IDAY, DECEMBER 24, 1880.

...tions for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

CANTOR LECTURES.

...th and concluding lecture of the first ...s delivered on Monday, 20th inst., by ... H. Church, M.A., F.C.S., on "Some ... Contact between the Scientific and ...spects of Pottery and Porcelain," in ...tention was specially directed to hard ...elains, Chinese, Japanese, and European. ...onclusion of the lecture, the Chairman ...RANCIS COBB, Treasurer of the Society) ...vote of thanks to the Lecturer for the ...g course which he had just brought to a ...

JUVENILE LECTURES.

... tickets for Mr. Romanes's Lectures ...ow been disposed of, the issue has been ... As all the available accommodation will ...ed for those members who have applied ...s, it will be understood that no member ...dmitted without a ticket.

...cretary will feel greatly obliged if any ... who is unable to use his ticket, will ...nd it back.

...EFORM OF THE PATENT LAWS.

...uncil adopted the following Petition to ...e of Commons, at their meeting on Mon- ...inst.:—

RIGHT HONOURABLE THE COMMONS IN PARLIAMENT ASSEMBLED.

...mble Petition of the Council of the Society ...Manufactures, and Commerce, incorporated ...Charter,

...TH,—

...t the Society is deeply interested in the ...w, and submits that it ought to be made ...e, as far as possible, to the progress of the Arts, Manufactures, and Commerce of this country, so as to allow the inventions of the United Kingdom to compete fairly with those of all the world.

2. That the Society, in the years 1850, 1851, and 1852, published reports on the Patent-law as then existing, and that those reports were instrumental in inducing Parliament and the Government to pass the Patent-law Amendment Act, 1852, which completely reformed the law.

3. That the effect of such reform has been greatly to stimulate invention, and has so increased the amounts derived from Patent fees, that they have now reached the sum of £180,000 a-year, of which only about £40,000 are expended in connection with the administration of the law, leaving £140,000 as a tax on the progress of invention.

4. That your petitioners are of opinion that the law still retains some antiquated fictions which should be abolished; that it should be greatly simplified; and that, as Patents relate to Arts, Manufactures, and Commerce, all matters connected with them should be administered by persons having knowledge of Arts, Manufactures, and Commerce, and not by legal functionaries, however eminent.

5. That your petitioners desire to call the attention of your Honourable House to the Patent Museum, which is in an unsafe, overcrowded, building, although it contains unique and valuable specimens of those early mechanical inventions which have revolutionised the Arts, Manufactures, and Commerce of the civilised world; that such Museum is quite unworthy of the Nation, and ought to be replaced by a suitable building, containing accommodation for a Reference Library.

Your petitioners, therefore, pray your Honourable House to cause the present Patent-law to be amended, and its administration to be entrusted to the Lords of the Privy Council for Trade.

And your petitioners will ever pray.

Signed on behalf of the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce,
H. TRUEMAN WOOD, *Secretary.*

The Council also appointed a Committee to draft a Bill for submission to the Government.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

SOME POINTS OF CONTACT BETWEEN THE SCIENTIFIC AND ARTISTIC ASPECTS OF POTTERY AND PORCELAIN.

By Prof. A. H. Church, M.A. Oxon., F.C.S.

LECTURE I.—DELIVERED MONDAY, NOVEMBER 22, 1880.

Terra-cotta, Bricks, Basaltes, Earthenware, and Unglazed Bodies in general.

There are several opinions now current as to the effect of scientific knowledge upon the artistic value of the products of manufacture. Some persons argue that the evidence afforded by the

consummate beauty of certain Greek vases of the "period of perfection" will suffice to prove not only that a rational, an intimate, and an exhaustive knowledge of the chemistry and physics of ceramic materials and processes is not needed, but also that it is certain to end in what we may term artistic disease, and the death of true beauty. They deem that knowledge, full, exact, unbending, fetters the imagination, and crushes the poetry out of the handiwork of man. Quite on the other side are ranged the devotees of science. Science, say they, must be master. Nothing is satisfactory but mathematical precision. Not content with explaining, by means of all kinds of analytical processes, the causes of the beauty of any product of human skill, these rigid disciplinarians permit no departure from established rule. But, happily, there is a third, and, we trust, an increasing, group of persons concerned with manufactures, who take a broader view of the requirements of the day. They are prepared to welcome every kind of aid, from whatever quarter it may come. They call in the assistance of the chemist to analyse old materials and to search by synthesis for new. They appreciate highly the hereditary and traditional knowledge and skill which, rightly directed by a sense of fitness and beauty, have often in past times been alone sufficient to produce results of the highest excellence. But they will be always on their guard against—they will not permit—the dull uniformity and the complete stagnation consequent upon a mechanical routine, however perfect. They may temper the individual originality, which cannot bear to be always producing the same pot, just as the true painter will not endure the too easy labour of continually painting replicas, even of his best picture. But the judicious director or manager will be ever on the search for new developments in art. He will strive to learn from, rather than to imitate, the productions of other countries and other times. He will press into his service every improvement in machinery, in grinding and washing the raw materials, in enamels and glazes, in kilns and the use of fuel; but he will not allow the accuracy of his processes to exclude the charms of variety and tenderness in his products. He will recognise the importance of the fact that such a thing exists as harmony between the material and its decorative treatment, both as to form and colour. He will not insist upon the application to the finest egg-shell porcelain of designs characterised by rugged picturesqueness, nor will he diaper a piece of rough-marbled clay with delicate reticulations of coloured golds.

But, after all, is it not clear that, if an excellence of result that will bear the test of time is to be achieved, the highest art-knowledge and the highest art-power must be affiliated to our potteries? The perpetual experimenting (untrained as much of it was) of Wedgwood, would have led to no very adequate realisation in actual ceramic products, had not the sweet and careful neo-classical art of Flaxman been available. With wider research, with profounder insight, with more numerous and more varied available examples of excellence; in description more full—in explanation more exact, in analysis more thorough, in suggestion more fertile, in taste more eclectic—the spirit of to-day, if more exacting than the spirit of yesterday, should at least make the attempt to secure, in some measure, that quality of rounded perfection which inspires our efforts, though, alas! too often only to condemn them. We enjoy greater and more varied opportunities of knowledge, and training, and execution, than Wedgwood, and we shall fail of our duty to ourselves and to our country, if we do not take full advantage of them.

Such views on the connection to be established between the sciences and the arts, which can be enlisted in the service of ceramic manufactures, have long been mine. Thirteen years ago, in an address to the Cirencester School of Art, I used similar language, dwelling with special emphasis upon the right use of the large resources which chemical knowledge bestows upon the art of pottery, and urging temperance in the employment of strong colours and showy glazes. These should be used to decorate and develop the beauty of fine contours and good forms, not to obscure them.

My special object in these lectures requires a few explanatory words. The general title of the course indicates its character, but not the limits which many causes combine to place upon my treatment of the subject which is to engage our attention. What then I propose doing in the present and subsequent lectures, is simply this—to note the relations existing between the chemical and physical qualities of some kinds of earthenware and china, pottery and porcelain, or whatever names we may use for these products, and their artistic qualities, as apprehended by the trained eye. On the one hand, I shall not attempt to offer instruction in practical potting, of which I know far too little for my own satisfaction; on the other hand, I shall make no pretence of scientific completeness in what I say on the chemistry and physics of my subject. From time to time circumstances have led me to analyse, or to examine microscopically, the raw materials and the finished products of certain ceramic wares, and I purpose dwelling upon the connections thus unravelled between texture and composition on the one side, and artistic effect on the other. Thus, it will happen that many important matters will not be so much as named, and that some trivial details will be thrust into places of undue importance.

As neither my knowledge nor your time would admit of a complete discussion of the large subject before us, you will, I trust, pardon the imperfections incidental to my treatment of relationships at once numerous and obscure. And now that I endeavour to place in orderly sequence some of the main features of to-night's subject, I feel perplexed by the difficulty of marshalling my facts. Perhaps my best plan will consist in first offering a kind of conspectus of the contact points on which I wish to dwell. We may set this down, then—

$$\left.\begin{array}{l}\text{Physical Structure}\\ \text{Chemical Composition}\end{array}\right\}\text{virtually inseparable}$$

affect

1. Form,
2. Surface,
3. Colour.

Form is the primary necessity of all good wares. If beauty of form be attained, the eye is satisfied; it demands nothing more. In the entire absence o

on, whether of surface gloss or of colour, t is felt. The satisfaction furnished by of form may be examined critically with ge, but I do not propose to consider this of the subject now. I want to draw your 1 to the two questions of surface and colour, s unglazed wares are concerned, adding l there a few observations on peculiarities d by pottery, which, though glazed, owes ficance to the body rather than to the glaze. ng up in order some of the specimens before shall be able, I hope, to apprehend the ions, which such products afford of ysical and chemical qualities of their nts. Plasticity, insolubility, contractility, ity, and chemical interaction, may be s included amongst the qualities thus to l.

is a specimen of common brown earthen- f Japanese manufacture. Three hemi- l cups of different sizes have been attached, ist thrown, by pressure to one another. r in which their form has been modified by pressure and contact, exhibits at once acity and plasticity of the moist clay. d example is furnished by this Japanese which, in lieu of a handle opposite to , has two depressions for finger and on opposite sides—depressions made in ist clay without breaking the continuity fabric. True, such unsymmetrical cavities upon the grotesque; and so, when workers r knowledge utilised such capacities of the lay, they added two or more further de- s, seen in many vessels of Greek and Roman

f, modelled from the cypress of Japan, he unchangeable character of a refractory he kiln. Upon all the minute and intricate this leaf, has rested for hours the molten et the sharpness of every original impress ould has remained intact. Neither fusion tion has occurred.

ompactness attainable with unglazed bodies tifully shown by those specimens of r ware, which were polished, partially or and inside and outside, on the lathe. e of a rich reddish brown hue, and bear as fine as the jasper and basalt wares of ood, which they antedate by fifty years or But this mode of achieving a fine surface be commended. It brings out no device ure, though it does illustrate a physical y of this ware, intelligible under the ope. At the high temperature employed g Böttcher's red ware, the alkaline matters have formed a slightly fusible silicious , in which the clay of the paste is firmly led; the resultant texture approaches that porcelain, and may be justly considered toneware. Yet, on examining the extant of this ware, often of large size and com- rm, one cannot help regretting that so much has been bestowed on this compact, but uninteresting, body—labour which might een much more profitably given towards elopment of the hidden beauties of some hard stone, such as agate or jasper.

wares, similar to the Dresden "red china" cher, were made, at one time, to a large extent in China, and, during the present century, in Japan. Here are half-a-dozen specimens, illustrating easier and more legitimate modes of decoration, than that originally devised by Böttcher. We notice upon these examples ornaments and devices worked in the unburnt ware. The methods employed are four, and we may characterise the several decorations as (1) incised; (2) inlaid; (3) onlaid, or applied; (4) impressed. Should the resources of these methods be deemed insufficient, the ware, after firing, may be adorned with coloured enamels; some beautiful examples of Chinese origin exhibit blue, green, and white enamels, which, by their surface lustre, as well as by their colour, contrast charmingly with the matt or half-dead ground. The so-called Mishima ware of Japan affords further illustrations of the inlaying of one clay with another, and recalls, in a measure, the chief characteristic of the *faïence d'Oiron* or Henri Deux ware. In the East, as in Europe, the range of colours in the body and its ornaments included, besides many shades of red and brown, buff, drab, and yellow.

No ware made in England, save that of John Philip Elers (1693-1710) and of his imitators and successors, quite equalled the "Eastern red dry china," as Wedgwood called the Oriental fabric to which I have been just referring. Wedgwood's own attempts in this direction were not equal to Elers's work, in fineness of paste or tone of colour.

The red tint of the greater number of the wares which I have described brings us to the consideration of its cause. Iron here, as elsewhere in the products of art as well as of nature, is the cause. This metal exists in clays burnt or unburnt in at least six states of combination:—

1. Anhydrous sesquioxide—causing a red or pink colour.
2. Hydrated sesquioxide—yellow or brown.
3. Pyrites—grey or blue.
4. Glauconite—grey-green.
5. Ferric silicate—yellow, buff, or fawn.
6. Magnetic oxide—neutral grey.

But it is not a mere question of the presence of one of these, for often two or more in the same body influence its colour. Through different amounts as well as qualities of iron compounds are the resulting colours influenced—further effects being produced by the several undermentioned conditions or materials:—

a. Heat of greater or less degree.
b. An oxidising atmosphere during burning.
c. A reducing atmosphere; or, carbonaceous matter in the ware.
d. Presence of lime or magnesia.
e. Presence of alkalies.
f. Presence of very fine ferruginous particles.
g. Presence of soluble alkaline and earthy salts.

By the consideration of the states in which the iron existed in the clay, and of the changes wrought by the conditions and materials just named, it is easy to explain and produce at will a very great variety of colour-effects in unglazed ferruginous pottery. Many examples illustrating this fact may be cited. Such are the buff and red terra-cottas of Watcombe, and those made at Copenhagen by Ipsen and Ahrends; the body and decorations of many Greek and Roman vases; the black ware once so abundantly manufactured in

Roman Britain; and a large variety of Japanese products, amongst which the mottled clays of the Imado and Banko wares should be particularly noted. But no better illustrations of the varied functions of iron in earthen bodies can be furnished than those which bricks supply. We have thin Roman bricks burnt right through, and completely oxidised; we have the thicker bricks of to-day, varying between brown and orange, according to their position in the kiln. Then there are the plum-coloured bricks of the Tudor times, and the orange-red of the close of the seventeenth and commencement of the eighteenth century. The sickly yellow bricks, blanched by added chalk, made from the London clay, are a good instance of the curious effect of lime upon ferric oxide, neutralising its redness, and even replacing it by a dull pale green. The Dutch, two centuries or more ago, made excellent impressed bricks, with good ornamental details; some are to be seen still at Walsingham and Ley. And the exquisite terra-cottas of the time of Donatello, still extant in Florence, show what forms of beauty can be realised in common and simple clay. It would be as well for me to draw attention here to the peculiar defective surface tint which some terra-cottas exhibit. If one portion has been more compressed than another, or if one part has dried first, there is great probability that the part so pressed or so dried, will be covered, after firing, with a firmly-attached film of irremoveable pale-coloured silicate, formed by the union of calcareous and other soluble salts (present in the water moistening the clay) with silica in the body. You thus get a sickly pallor where it is not wanted, as on the cheeks; while lights appear on edges and in shadows, and distort the modelling.

Thus far, I have spoken chiefly of colour stains of earthenware bodies attributable to iron, and yet I have by no means exhausted the subject, for I have not even alluded to these agate wares of the eighteenth century, made at Staffordshire and at Apt. But I must, at least, mention the coloured clays which Mr. G. Maw and the Campbell Tile Company use so successfully in their encaustic tiles. Here we have the oxides of cobalt, manganese, copper, and chromium tinting the unglazed clays throughout their substance, and yet, in most cases, not modifying the hardness of the body. One of Mr. G. Maw's specimens seems to owe its spangled touches of puce to the partial combination with the paste of minute fragments of pyrolusite.

Leaving for future consideration the characteristic capabilities of many other kinds of earthenware bodies, I may conclude the present discourse with a few words on the subject of texture. Many ingredients may be (and some have been) introduced into a paste or body, rather to influence its texture than its colour. The satiny aspect of wares containing abestiform minerals, though developed by a glaze, is perceptible without such aid. Laminated and acicular minerals and artificial compounds lend themselves more readily to this end than do substances presenting greater solidity. The difficulty which the association with the clays of dissimilar compounds involves, is due to the unequal expansion and contraction on being heated or cooled, which the different substances suffer. But the Japanese, in the specimens which I brought here to illustrate this matter, seem to have overcome this difficulty, at least, to a considerable extent.

It would be wrong for me to conclude my lecture this evening, without special mention of the kindness with which my request for the loan of specimens has been met. With a single exception, to ask was to obtain. To Messrs. Mintons, of Stoke-upon-Trent, Messrs. G. Maw and Co., of Broseley, the Campbell Brick and Tile Company, and Messrs. Londos and Co., the extensive importers of Oriental wares in London-wall, I must express my large obligation for many of the illustrative examples to which I have been directing your attention to-night.

MISCELLANEOUS.

NOTES ON USEFUL PLANTS.

(*From the Kew Report for* 1879.)

The report on the Royal Gardens, Kew, for 1879, which has recently appeared, contains some notes on the introduction and acclimatisation of useful plants into India and the Colonies, which may be interesting to the readers of the *Journal*.

With regard to those important medicinal plants, the Cinchonas, Sir Joseph Hooker deals firstly with what are known as Columbian barks, namely, those producing the Calisaya of Santa Fé, and the hard Carthagena barks. Both of these are of an extremely valuable kind, and only a few plants remained at Kew at the close of the last year. One of these was sent to Jamaica, from whence the Superintendent of the Botanic Gardens reports:—"Our specimen of Carthagena bark is in splendid condition. We have now seventeen well established cuttings, with promise of more." The remainder of the plants were sent to India, and a subsequent report from Calcutta says that they are doing well, and there is every probability that they will soon be successfully propagated.

Regarding the extended cultivation of the well-known species of Cinchona, *C. succirubra*, *C. officinalis*, and *C. micrantha*, reports are given from several centres. Thus, from Assam, Mr. Mann says, with respect to the small patches of Cinchona plantations below Nungklow, in the Khasia Hills:—

"*Cinchona officinalis* appears to be healthy, the other two species (*Cinchona succirubra* and *Cinchona micrantha*) all present a sickly appearance, and most of them have only a few leaves at the extremities of the branches. Both species flower sparingly and form no good seedpods. This condition of the plants is ascribed not so much to the climate and altitude as to the very steep slope and shallow surface soil resting on rock, which does not retain sufficient moisture to suit these plants. The plants of *Cinchona succirubra*, near Jirang, look very much better, and both altitude and situation, as well as the soil in that place, seem to be more suited to this species than in the Nungklow plantations."

From Burma, the report of Major Seaton is not very favourable on the prospects of Cinchona cultivation. The plantations seem to have been made so far back as 1879. He says:—

"'All things considered, the Cinchona experiment does not promise well. The oldest trees dying off, and the trees of very small size flowering and fruiting freely, are only too sure signs that the tree finds itself in a site not adapted to its requirements.' It appears, however, that a Ceylon planter has made inquiries about a grant of land in the neighbourhood. It is possible that with the technical knowledge as to the methods of cultivation of Cinchona, and of obtaining a speedy financial return from it, which have been worked out in Ceylon, a better face may be put upon the experiment in Burma."

At Gadcrif, near the frontier of Abyssinia, *Cinchona succirubra* is said to do well. In Ceylon, it is stated that—

"The enterprise of the planters, and the necessity of obtaining a speedy return for invested capital, has led to much more rapid

of harvesting the bark crop being adopted in this island the first commencement of the enterprise would have been possible. The following statement appeared in the *bserver* for September 13th, 1878:—'Over large areas in seems as if *Cinchona officinalis* came to maturity in four f years, while if trees begin to show signs of canker or even two and a half years, the bark ought at once to be Bark of such trees will pay well for the gathering. We to Messrs. Howard a specimen of bark from three and a s old trees. The verdict was, 'good marketable bark as '"

Jamaica, the Superintendent of the Botanic s writes:—

hief care at the Cinchona plantation is the establishment pen air nurseries instead of the glass propagating houses found here. I sow the seed under thatched sheds and the plants into beds shaded by ferns. This is a simple ive style, which is universally adopted in Ceylon, but here. I fear that the system of glass houses and propa- d hardening frames has done much to frighten people g Cinchona here, and besides [the Government planta- e never been able to distribute more than a few hundred they had not enough for their own use. In a few y next planting season, I shall have 80,000 which I can tly spare, and by the end of the year, possibly • • • • "Unless the trees are planted thickly 'bower' the ground, as the planters say, the cost of nearly £4 per acre per annum. By the third year the ell planted and well supplied, ought to cover the ground ll subsequent weeding."

Mauritius:—

Cinchonas have grown but slowly. Few experiments made with the plants, owing to more pressing work. s planted in the forests at a greater altitude than that of ns have not grown satisfactorily, but it is hoped some growing this useful plant, which will give beneficial ay still be hit upon; only it must differ considerably of other countries."

Singapore:—

rton (Superintendent of the Botanic Gardens) reports:— mpts to grow this here have proved fruitless, but *calisaya* and *Cinchona succirubra* are likely to do well at elevation in Perak."

e from Tinnevelly:—

ddome reports:—"A few plants were sent from the or trial in this district (1866), and the *Cinchona succirubra* ere put down at an elevation of about 3,000 feet, in a aring in the ghât forests; they have been left entirely to but owing to the moister climate, the growth contrasts ourable with that of Neddivattum or elsewhere on the During my last inspection I found one of the larger be nearly 50 feet high; it had three large stems at about from the base, the leaves having, it was said, been broken nkey when young."

garding the cultivation of Cinchonas in Sikkim, the of Dr. King, published in the *Journal* for Septem- d last, p. 809, is of a subsequent date to that l in the Kew report.

the subject of Eucalyptus planting, Sir Joseph r reports as follows:—

of species of this Australian genus are continually asked supplied from Kew. The following notices represent the made in the cultivation in various parts of the world:—

L.—Mr. Gustav Mann reports:—"*Eucalyptus globulus* is he fastest growing species cultivated in the Khási Hills, t to it comes *Eucalyptus rostrata*."

AL.—Dr. King remarks:—"The Eucalypti from Queensland le more hope of success than the more southern species, planting of which in the plains of Bengal sanguine people o abolish malaria."

AY (NORTHERN DIVISION).—Mr. Shuttleworth reports:— of different varieties of Eucalyptus were sown; nearly all A few of *E. rostrata* are surviving."

AY (SOUTHERN DIVISION).—Col. Peyton reports that the plan- of different species of Eucalyptus do not appear to prosper, heir numbers are rapidly diminishing." . . . "They are and whip-like in growth, and require to be propped up to t falling over." Near Dharwar what is supposed to be *E.* re appears to prosper. "Four trees are remakably fine, gh only six years old. They have attained on an average high, and are five inches in diameter five feet from the L."

ICA.—Mr. Morris reports:—"Of Australian trees the most le here is *Grevillea robusta*, which is adapted for nearly all ses, and stands wind well. The gums (*Eucalpytus*) get very slowa and seldom look well except in clumps, where, for the ur or five years they are sheltered on the outside by other "

ARUNPORE.—Mr. Duthie reports:—"There are at present up- of 31 species under cultivation in these gardens." . . . .

"The healthy appearance of some of the kinds, and the rapid growth they are making are sufficient reasons for encouraging their extensive cultivation in India." This is in accordance with what is known of the climate of that (extra-tropical) part of India.

SINGAPORE.—Mr. Murton reports:—"When sown *in situ* they seem to thrive fairly well in Singapore, but do not appear to stand transplanting. *Eucalyptus siderophloia*, *E. Baileyi*, and one or two other species are growing well in the nursery."

ZANZIBAR.—Dr. Kirk informs me:—"The *Eucalyptus citriodora* from Queensland is now in less than two years from seed about 18 feet high, with wide branches."

On the very important subject of fodder plants, the Kew authorities have a great deal of information, as the following extracts will show:—

GUINEA GRASS (*Panicum jumentorum*).—This, it appears takes the place of all other fodder grasses in Dominica, as it is hardy and requires but little cultivation.

Dr. Imray says:—

"By keeping the lands down and a little manure occasionally, it may be cut down, crop after crop, for many years. I have had a guinea grass piece treated in this way for full twenty years."

PRICKLY COMFREY (*Symphytum peregrinum*).—From various trials that have been made, it has been shown that this plant, although of great utility as an early fodder crop in cool and temperate countries, is not adapted for cultivation in hot countries:—

MADRAS.—The Agri-Horticultural Society report:—"Experiments with Prickly Comfrey have failed, the plants which were in the gardens, though receiving rather more than their fair share of attention, having one by one perished."

SAHARUNPORE.—Mr. Duthie reports:—"I do not believe that the conditions at Saharunpore, as regards either climate or soil, are favourable for the profitable cultivation of this plant. At Chajuri it thrives fairly well. Three crops were taken during the year from 35 roots growing 3 feet apart. The average weight of each crop was 30 lbs."

SOUTH AUSTRALIA.—Dr. Schomburgk reports from Adelaide:— "Prickly Comfrey has again been a thorough failure, and it is now a fact that this plant is of little use; at least, on the South Australian plains."

On the Téosinté (*Euchlæna luxurians*), Mr. Woodrow reports as follows from Bombay:—

"*Euchlæna luxurians* produced a heavy crop of forage when treated as a garden plant, but not better than would be given by sugar-cane in the same circumstances. When treated as a fixed crop, under the same conditions as Jowaree, the produce was inferior to that crop."

QUEENSLAND.—Mr. Walter Hill reports from Brisbane:—"The seeds received by me were duly planted, and grew both strong and healthy, flowering about the month of May. From the opportunity I have had of judging of its nutritive qualities, I am not of opinion that it can be grown to much advantage in this colony; the stalks appear to be too fibrous and hard to possess much nourishment. I shall, however, make further experiments."

SAHARUNPORE.—Mr. Duthie reports:—"As far as cultivation is concerned, success has been complete. The majority were fine, healthy plants, and an abundant supply of excellent seed was produced."

SINGAPORE.—Mr. Murton reports:—"This grass, although useful, does not bear out its reputation in the Straits. Large quantities of seeds have been distributed, but all accounts from the Native States state that it pays far better to grow maize, as the same ground that will grow Téosinté will produce excellent maize."

SOUTH AUSTRALIA.—Dr. Schomburgk reports from Adelaide that, notwithstanding the disastrous drought of the early part of 1879, "the prevailing dryness did not injure the plants, showing not the slightest effect on their leaves, which preserved their healthy green, while the blades of the other grasses suffered materially. . . . At the Government garden, at Palmerston, in the Northern Territory, the growth of the *Euchlæna* has been surprising. In the course of five or six months the plants reached the height of 12 to 14 feet, and the stems on one plant numbered 56. The plants, after mowing down, grew again several feet in a few days. The cattle delight in it in a fresh state also when dry. Undoubtedly, there is not a more prolific forage plant known. . . . . I can recommend it as a most valuable summer forage plant in our dry climate, especially if it can be planted in a moist soil. The only drawback with us will be that the ripening of the seed crop will be problematical, as early frosts will kill the plant."

The most recently introduced fodder plant is known as the Tagasaste (*Cytisus proliferus var*).

"It is a shrub indigenous to the Canaries, the leafy branches of which are said to be a useful fodder. It requires a light dry soil, and is rather intolerant of frost in winter. The plants should be placed 6 to 10 feet apart, may be cut two or three times a year, and will last 10 to 20 years. Thirty-five pounds of fresh-chopped Tagasaste mixed with 20 lbs. of chopped straw is said to be sufficient for the daily nourishment of a horse or cow. The seed

is very slow in germinating. The seed was pretty widely distributed from Kew. It is too soon to expect the results of trials at present."

MADRAS.—Most of the seedlings died off after germination. Colonel Grant reports at commencement of present year:—"At present only two or three are looking healthy, and from them I should think very little fodder could ever be obtained."

SOUTH AUSTRALIA.—Dr. Schomburgk reports from Adelaide:—"The seeds were sown, and all came up. The growth of the plant is vigorous, some of the plants having reached 2 to 3 feet, looking healthy, not in the slightest degree affected by the severe dry weather we have had to contend with. I have many plants for distribution."

The supply of India-rubber, or Caoutchouc, is a question that has of late years occupied the attention of commercial as well as scientific men. It has received a good deal of attention at Kew, as the following extracts from reports from various parts of the world will show:—

1. CASTILLOA.—SINGAPORE.—Mr. Murton reports:—"The plants of Hevea and Castilloa in the gardens are now large plants, but hitherto propagation from the strong growths they are making seems rather difficult, whereas they used to propagate freely from the weak wood produced while in pots."

2. CEARA SCRAP (*Manihot Glaziovii*).—BURMA.—Major Seaton reports:—"A quantity of seed of this India-rubber tree was received during the latter part of the season from the Botanical Gardens, Peradeniya, Ceylon; and at the request of Dr. Thwaites, an intelligent lad was deputed to Ceylon to receive instructions in the cultivation of India-rubber plants."

CALCUTTA.—Dr. King reports:—"The Ceara rubber promises to grow well in Calcutta. The seedlings received from Kew have thriven vigorously, and some of them are now 20 feet high. The Director of the Botanic Garden in Ceylon having, at the request of the Secretary of State for India, undertaken the propagation of this species, a quantity of seeds of it were distributed by him to Indian officers during the year. Supplies were, I understand, sent to the Conservators of Forests in Burmah and Assam, and to the Inspector-General of Forests for Madras. A large supply was received at this garden, and a thousand seeds were sent, at the request of the Conservator of Forests for Bengal, to the officer in charge of the forest plantation near Chittagong. The seeds received here have begun to germinate, and I expect before long to be in a position to issue supplies of seedlings for trial in different parts of the country. The plant appears to thrive very well in Upper India, and if the quality of rubber yielded by it in this country turns out to be good, its introduction may prove of much importance."

SINGAPORE.—Mr. Murton reports:—"Ceara Scrap rubber must be omitted from the list of rubbers adapted to the climate of the Malayan Peninsula, as it has invariably rotted off during continued wet weather."

ZANZIBAR.—Dr. Kirk informs me that with him the Ceara rubber yields seed most abundantly, but the seeds are slow to germinate.

3. HEVEA.—BURMA.—Major Seaton reports.—"At Mergui eight Pará India-rubber trees, the survivors of the batch of seedlings received from Dr. King in 1877, continue to do well in the office compound, and vary in height from 8 feet to 25 feet. . . . They are large enough to admit of a considerable number of cuttings being taken from them."

CALCUTTA.—Dr. King reports:—"Pará rubber, of which 14 plants were alive in the garden at the date of last report, continues to be as disappointing as ever. Most of these 14 plants are still alive, but they have not grown much, and it is quite clear to me that it is vain to hope that this species can ever be cultivated to profit in this part of India. Plants may be coaxed into growing in conservatories, but the species is by far too thoroughly tropical to withstand without protection the vicissitudes of the climate of Northern India. As I have before reported, I believe it is useless to try it anywhere in India, except in the south of Burma or the Andamans, and perhaps in Malabar. I learn from Dr. Thwaites that in the Botanic Garden at Peradeniya, in Ceylon, there are plants of *Hevea* of about 30 feet high, and that these are of the same age as the plants here, the highest of which is barely 6 feet in height."

JAMAICA.—Mr. Jenman reported:—"I regret to say that there are only two plants of the Pará rubber in the garden, one which I brought with me, and which is now a vigorous young tree 10 feet high, the other, the only one saved out of a case of 16 plants sent from Kew Gardens over two years ago, but which unfortunately on its arrival in Kingston was locked up in the Custom house for over a fortnight, to the influence of which, after the voyage, all but the one succumbed. The atmospheric conditions of this district appear favourably adapted to the successful cultivation of the Pará rubber."

ZANZIBAR.—Dr. Kirk states:—"The Pará rubber is a less quick grower than the Ceara, and does not branch. It is 10 feet high."

Like India-rubber, Liberian coffee, about which so much was written and expected a few years since from its introduction and acclimatisation into many of the British Colonies, has received a considerable amount of attention in the present report. In Burma it is said to be thriving, and showing signs of flowering, s is hoped some opinion of the economic value coffee may soon be known.

From Dominica, the late Dr. Imray w follows:—

"I am glad to say that the Liberian coffee cultivation be fairly considered as established in this island. healthy, luxuriant trees on my small plantation, with berries on many of them, afford sufficient evidence of tl being congenial to the plant. The cultivation is succe only awaits extension by others taking it up. I ha thousand seedlings planted out in the open, and thrivir lost a good many seedlings, however, by putting them too small. To ensure their r oting they should be g grown before they are transferred to the field. Protecti kind or other is also advisable at first, as well from the rays of the mid-day sun as from strong winds. When fa and growing, the plants are hardy enough, and will b deal of exposure and neglect."

Dr. Imray further remarks on the coffee-lea of Dominica (*Cemiostoma coffeellum*), which cumbed in clearing off the old *Coffea Arabic* but which it was hoped would not find a rest on the new plants, that it really had attacked t in their very young state, and only on the coty leaves. The leaves were cleared by killing tl and brushing off the chrysalis wherever it ap after this the seedlings steadily increased i throwing out fresh leaves, after which most (were planted out in the field, and were thrivi with not a speck of the blight on them. Dr. says:—

"This, however, is not the only attempt the insect ha gain a footing on the Liberian coffee. On carefully exam large trees some six or eight months ago, a few leaves w where the insect really had established itself, but in a w manner. Some of the larvæ were lively enough, but ol and weak, and the skeletons, if I may so speak of other died, were found in the brown patches of the leaf, when and under cuticle were separated. Very few coco observed, and these were smaller than usual."

This report from Dominica, which is given in in the Kew report, concludes with advice a absolute necessity of protecting the seedlings ravages of the white fly, without which protec few of the plants will be saved.

In Jamaica it seems there is a great demand planters for this kind of coffee, but attempt part of private persons to import either plants have failed. The plants, however, in the Botanic Garden, have ripened their seeds, wh been sown to increase the stock.

From Seychelles, Mr. E. S. Salmon, the Chi missioner, writes:—

"About 150 plants of Liberian coffee—mostly raised you sent—have been planted at Mahé Island, at elevatio from the shore to 1,500 feet above sea-level. It c apparently so far, in the open without shade. One p elevation of about 300 feet, without any shade and granite rock giving out considerable heat, has about looking flowers on it. This plant is 18 months old."

From Singapore:—

Mr. Murton reports:—"The Arabian coffee here is a tacked by the disease (*Hemileia vastatrix*), which has de hopes of our being able to supply seeds for planters in sula. The Liberian coffee has not yet shown any signs o tacked, although some Perak planters have been scared blotches on the younger parts of the branches." (They have no connection with the disease.) "The species is very impatient of deficient drainage. The plants raised received from Kew in May, 1878, are now blooming Eight hundred fruits from our plants have been sent t ment Hill, Penang, and 500 sent to Perak. Very reports have been received from the Native States reg progress of the plants of this species there, and there c no doubt that the Liberian coffee has found a congeni the Malay Peninsula and adjacent islands, and its futur tion may now be left to planters."

In Queensland, Liberian coffee is said to hav thoroughly established on the Herbert river, promises to attain complete success; while from the plants are reported to be in flower.

e subject of mahogany cultivation in the Old Sir Joseph Hooker writes as follows:—

may now be regarded as an accepted success. The tree rell in many parts of India and in Ceylon, and in the there is a local demand for the wood. In this country new found for it, one of the most recent being for the linings ceilings of railway carriages instead of teak, which is now ely used for ship building. It is not easy to see any valid against the cultivation of a tree, the timber of which excellence for a variety of purposes, and the growth is apparently attended with little difficulty. As late as the Government of Bengal was adverse to mahogany plant- This policy has now, however, been modified, and in his for 1880-81, Dr. Brandis, the Inspector-General of Forests, :—'Of the exotic trees which are cultivated by way of mahogany is the most important, and its success is not improbable, though it is too early yet to form final con- upon the subject.' Mahogany is also cultivated as an ex- in Burma and the Chittagong district of Bengal. The is known to thrive well near Calcutta, and every effort should to cultivate it in those forest districts where climate and circumstances are favourable."

m Bombay, Burma, Saharunpore, and Singapore rable reports have been received of the cultivation hogany, while in Queensland, seeds have been uted for sowing.

er the head of "Food Products," attention is to the desire of the Indian Government to introduce racacha esculenta, a South American plant, produc- edible root. A reference is also made to the use chestnut as an article of food in the Apennines. made from chestnut-flour which had been pre- to the Kew Museum were found upon analysis fessor Church to contain over 40 per cent. of us matter soluble in pure water. Professor thinks, therefore, that chestnut-flour should be y-digested article, and suitable for children's good deal of consideration is given to vegetable substances suitable for paper-making, besides and useful and ornamental woods. The length notes, however, precludes any detailed notice of bstances.

TERNATIONAL WOOL EXHIBITION FOR 1881.

ecial report on the American textile industries ladelphia has been received from the Foreign by the Directors of the Crystal Palace.

wool trade of the City of Philadelphia is very Nearly one thousand mills are kept running on fabrics, employing over 100,000 persons, and ng thirty-one millions sterling of woollen, , cotton, and silk manufactures per annum. The wool for manufacture in Philadelphia and its amounted, for the year ending April 1st, 1880, 00,000 lbs., and the production of manufactures, ng of fine woollen and worsted yarns, carpets and wool), clothing, blankets and fibrous , hosiery and knitted goods, amounted to 000. The wool production in the United States to 300,000,000 lbs., and the manufacture there- qual in value to one dollar per pound of wool. nal importation of wool is from 30,000,000 lbs. ,000 lbs. Thus there is a manufactured pro- from the wool growth and importation of 000 for the United States.

nsumption of cotton in the manufactures of the Republic is equally remarkable. About one- the American crop is consumed in Penn- 1,500,000 bales of the annual crop having been taken by the Philadelphia spinners. Of the 879, which was 5,200,000 bales, the exports 5,226 bales (up to August 25th, 1880), and the ion in America, 1,125,000 bales. The crop of so far as the returns of the gathering have mounts to 5,760,000 bales, which, at £9 5s. igure up a value of £53,280,000. One-fourth of this product, manufactured in Philadelphia, shows an industrial total of £13,320,000. The wool production for 1880, is estimated at 300,000,000 lbs., at a value of £1,875,000, and the exportation of 65,000,000 lbs., valued at £406,200, added thereto, give a stock for manufacture in the States, equal to £62,000,000 of manufactured products thereof.

The manufacture of three textile articles in the United States can safely be placed thus for the year 1880:—

	Dollars.	£.
Cotton	250,000,000	52,000,000
Woollens....	300,000,000	62,000,000
Silks	30,000,000	6,200,000

The leading American manufacturers have expressed their willingness to take a prominent part in the forthcoming Exhibition, by showing wool, woollen manufactures, and machinery.

A large number of applications have also been received from British engineers and machinists for space to exhibit machinery in motion, and a committee of advice, consisting of official representatives of the Colonies, and foreign States, and gentlemen interested in International Exhibitions, has been formed.

TECHNICAL MUSEUMS.

A paper was read by Mr. Alderman W. H. Bailey, on "Technical Museums and Libraries," at a late meeting of the Scientific and Mechanical Society, Manchester. He said:—"If it be proper to establish free libraries for the benefit of the people in order that general knowledge may be acquired, it seems but reasonable that if it can be shown that there are certain trades on which the bulk of the people of a town are dependent for bread, and that full knowledge of those trades can only be imparted by means of models and drawings, that it is quite as legitimate to have free trade or technical museums as free libraries; the sole object being in both cases to increase the prosperity of those who pay the public rates. Foreign competition is becoming keener every day, and we must recollect with all seriousness that we have not always been the leaders in manufactures; indeed, before the invention of the steam-engine it would be difficult to name any great industry in which we were superior to other nations. The Dutch, the Spaniards, and the French and Italians were infinitely superior to us, and when all the world become proprietors of steam-engines, which is an exaggerated way to put the question, only those who can use the forces of Nature with the highest wisdom will be able to be first in the race. To the members of a Society like this it requires very little argument to illustrate the value of models and drawings over mere descriptions of machinery or processes. Our great inventors at the commencement of this century have nearly all been men of ancestral power—some call it natural ability in contradistinction to that ability obtained by education—and by that high skill called culture, these men, not having much to do, made single great discoveries. I say this because there exists a popular delusion that inventors very often are lucky guess-work men, who have been accidentally successful. My experience of men who have risen to positions as foremen and managers is that they have their positions because of their integrity, industry, and, to use the phrase again, natural ability. This class of leaders in our works are the very pick of the working classes, who have risen to their positions by reason of the qualities I have named, and it is for such who thirst for knowledge, as I know they do, and for young men who wish to aspire to similar positions, that I would advocate the establishment of technical museums. Now, what is wanted is a

museum in which first principles can be illustrated by means of models and sectional drawings. Let me speak with some diffidence, when I recommend that the cases of stuffed birds which exists in our museums be removed, and that their places be filled with objects of greater interest to those engaged in the trade of the district." The reader of the paper proceeded to state that in his opinion, the museum should consist of models as well as books, that it should be a technical museum and library, the models should be of interest to those engaged in the trade of the district, and each district would of course require a different style of museum. One at Halifax would be different to one at Bolton. The various industries, silk, cotton, flax, wool, being too vast for one museum, it would be less costly and more beneficial to let each have its speciality. The science examinations, the Whitworth scholarships, and the whole educational work of the country all do good work, indeed, far better work than had ever been done in this country before, but a great deal yet remains to be accomplished in every direction.

COLOUR RELATIONS OF METALS.

In a paper on the colour relations of copper, nickel, cobalt, iron, manganese, and chromium, lately read before the Chemical Society, Mr. T. Bayley records some remarkable relations between solutions of these metals. It appears that iron, cobalt, and copper form a natural colour group, for if solutions of their sulphates are mixed together in the proportions of 20 parts of copper, 7 of iron, and 6 of cobalt, the resulting liquid is free from colour, but is grey and partially opaque. It follows from this that a mixture of any two of these elements is complementary to the third, if the above portions are maintained. Thus a solution of cobalt (pink) is complementary to a mixture of iron and copper (bluish green); a solution of iron (yellow) to a mixture of copper and cobalt (violet); and a solution of copper (blue) to a mixture of iron and cobalt (red). But, as Mr. Bayley shows, a solution of copper is exactly complementary to the red reflection from copper, and a polished plate of this metal viewed through a solution of copper salt of a certain thickness is silver white. As a further consequence, it follows that a mixture of iron (7 parts) and cobalt (6 parts) is identical in colour with a plate of copper. The resemblance is so striking that a silver or platinum vessel covered to the proper depth with such a solution is indistinguishable from copper.

There is a curious fact regarding nickel also worthy of attention. This metal forms solutions, which can be exactly simulated by a mixture of iron and copper solutions; but this mixture contains more iron than that which is complementary to cobalt. Nickel solutions are almost complementary to cobalt solutions, but they transmit an excess of yellow light. Now the atomic weight of nickel is very nearly the mean of the atomic weight of iron and copper, but it is a little lower, that is, nearer to iron. There is thus a perfect analogy between the atomic weights and the colour properties in this case. This analogy is even more general, for Mr. Bayley states that in the case of iron, cobalt, and copper, the mean wave length of the light absorbed is proportional to the atomic weight. The specific chromatic power of the metals varies, being least for copper. The specific chromatic power increases with the affinity of the metal for oxygen. Chromium forms three kinds of salts. Pink salts, identical in colour with the cobalt salts; blue salts, identical in colour with copper salts; and green salts, complementary to the red salts.

Manganese, in like manner, forms more than one kind of salt. The red salts of manganese are identical in colour with the cobalt salts, and with the red chromium salts. The salts of chromium and manganese, ac to the author, are with difficulty attainable in of chromatic purity. He thinks these propertie metals lead up to some very interesting conside

PRODUCTION OF BRICK TEA IN HAN

The Commissioner of Customs at Hankow that the importance of the brick tea trade is in creasing, and the demand becoming greater supply. The employment of steam machi pressing the bricks has proved in every wa success, the steam-pressed brick being mu finished than that produced by hand, and m pact and firm, withstanding the difficulties better, and ultimately arriving at its destination little, if any the worse, for its journey. Wi method, the bricks, from insufficient pressu were liable to chip and crumble at the edge great stress is laid on the perfect appeara brick by the Siberians, it can be easily unders a hard, sharply defined brick would at once o preference. With both methods of manufactur tea there is a drawback, and a serious one—th ing of the dust by steam, which robs it of fragrance. To remedy this defect a firm has an hydraulic press, which turns out small co shaped cakes, weighing a quarter of a poun retaining the original aroma in all its freshness has not, says the Commissioner, been sufficient t to ascertain whether the compressed tea will p success or not, but samples sent to Siberia hav favourably reported on; and as the improvemen ordinary brick was so quickly recognised, it is e that similar popularity will attend the latest ments. The two kinds will probably run side in friendly competition, as the brick will keep i position for use among the masses, and the com tea will become popular amongst the better clas if really fine dust be employed in its manufac may, from its portableness and cheapness, g take the place of the leaf tea at present annu overland from Shansi. The following is the me producing the brick tea. There are at present si factories in Hankow, in three of which boilers either for steaming the tea, or both for that and furnishing power for pressing. The du which brick tea is made comes principall Ningchow in Kiangsi, and Tsung-yang and lout'ung, in Hupeh, and varies both in finen cost, according as it belongs to the first, sec third crop. From four to ten taels is the avera The first operation is to sift the dust and reject sand and rubbish contained in it, usually amou about 5 per cent. It is then placed in a win machine having three different sized sieve troughs corresponding, and passed into basket residue which is too coarse to pass any of th is taken out and trodden until it is reduced to th consistency, when it is placed in iron pans over coal fire until it is sufficiently brittle, when it i taken to be winnowed, and this operation is r until all has been sifted to the requisite de fineness. Three sizes are produced, the coar being employed to constitute the brick, wl finest dust is only used as a facing. The dust been properly sifted, the next step is to pr for pressing, and this is done by exposing it action of steam for three minutes, and it steaming that robs brick tea of its scent and and for which a remedy is eagerly sought. fashioned apparatus of native design consists iron boilers heated by charcoal, and having over which are fitted with rattan covers. W dust is to be steamed, it is spread out on a sheet o

aced over the boiler and covered up; but with proved European apparatus the dust is simply to iron boxes and the steam then passed through. After having been sufficiently steamed to make esive, the dust is put into a strong wooden mould e moveable cover of which the trade mark of the g" or firm is engraved, so as to leave the corresng impression on the brick) and firmly wedged . It is then pressed and placed on one side for these hours to cool. Each brick should weigh one y, and all those that do not come up to the proper ard of weight, or are defective in any way, are sted and re-made. For this purpose they are taken rotatory mill, constructed of two heavy circular s, moved by a horizontal wooden bar, and working channel where the condemned bricks are thrown, crushed as the wheels pass over them. Having become dust, the operation already described is, in details, repeated. The hand press turns out sixty ts a day, with 25 per cent. of failure bricks, while team press produces eighty baskets a day, with 5 per cent. of bad work, and the saving, by the yment of the improved machinery, amounts to one basket, or, according to the above stated out-turn, taels a day, or about £20 sterling. The bricks found correct in weight and free from defects are stored drying-room for a week, when they are carefully ed separately in paper, and packed in bamboo s containing sixty-four bricks each. Green brick made in the same manner, but of leaf, not dust, e bricks are larger, weighing two pounds and a-ach, thirty-six going to a basket when packed for . During the past year only two factories in the t, at Tsung-yang and Yang-lout'ung, were working, and it is expected that in a short time, hole trade will be transferred to Hankow, to the of its position as a commercial centre, and to eneral interest of those connected with it. In n to brick tea proper, there is also another kind called "medicine tea," which is composed of leaf and stalks, mixed with various kinds of inal herbs, and packed in bundles weighing sixty-atties. It is valued at five taels per picul, and in unt of the cost of transhipment to Central Asia ientsin, instead of as hitherto from Shansi, proving ntly low, it is expected that the trade will receive ased attention.

ing to the immense quantities of brick tea now ing at Tientsin for transport overland, it is both difficult and more expensive to obtain sufficient s, than it was a year ago, and it is anticipated he sea and river route *viâ* Tientsin and the Amoor oon be substituted as a necessary consequence of owing magnitude of the trade.

CORRESPONDENCE.

NATIONAL INDUSTRIAL CONGRESS, BRUSSELS.

cent number of your *Journal*, I find the report st Congress of Industry and Commerce (Vol. 29). In this report, which I consider very good ou omit to mention what led to the important n I put forward, and which was unanimously The following is taken out of the *Echo du Parle-* shows what took place on the 9th September

Splingard said that the question of an in-teaching was one most interesting for the eople, and was in close connection with teach-general. What the German speaker had asked, could only be resolved in a Congress where questions of general teaching as well as trade-arts were discussed. In all civilised countries of Europe, we find a succession of studies through which learners are bound to go to obtain a good education.

"Is the case similar in the teaching of industrial arts? Indeed, a great difficulty arises here. Some industries can not be taught; for instance, the working of coal pits and the manufacturing of iron. In these cases, it would be desirable that such large establishments should be open to students, through some general concert between the employers; some of them have so been opened. There are also the different manufacturing industries, in which it is necessary to join to the workshop a school of apprentices. Practical people ought to make the distinction, and the men of industry are the best judges. But should they fail to fulfil their part, the State would then but fulfil its duty by opening industrial schools.

"The Government would have to recognise that industrial teaching is a question of public utility, and that, in case a part of the country requires it, a subsidy ought to be voted for such new schools. The industrial schools, with the workshops in connection, ought to be considered as objects of public utility."

Will you insert these few lines in your next number. Your previous report will gain in precision, and you will oblige me, as I admit I attach a great value to the question of industrial teaching.

PIERRE SPLINGARD,
Membre du Conseil Provincial du Brabant.

5, Place de l'Industrie, Brussels.

SIGNALLING BY MEANS OF SOUND.

In my paper on the above subject, I have unintentionally done an injustice to Professor F. H. Holmes, by giving the credit of certain new forms and applications of siren instruments to Messrs. Sautter, Lemonnier and Co., of Paris (see p. 75). I beg leave, therefore, to be allowed to correct my error, and to express my regret that the source from which I obtained the particulars in question was inaccurate.

Professor Holmes now informs me that Messrs. Sautter, Lemonnier and Co. have simply manufactured instruments from his designs; that the double siren is his invention, and was patented by him in 1875; that the siren arrangement for locomotives is also his design, and was placed in Messrs. Sautter's hands for manufacture.

I am anxious for the insertion of this letter, as I should indeed be sorry that a gentleman who has given so much attention to the subject, and worked so meritoriously in connection with it, should, in any way, suffer from any misrepresentation on my part.

I should like, at the same time, to state, with reference to my remark, that the results of the South Foreland experiments "are stated at length in the third edition of Dr. Tyndall's book on 'Sound,'" that the results are given at length in the "Philosophical Transactions" for 1874, and are concisely stated in Dr. Tyndall's book. E. PRICE EDWARDS.

Trinity House, London, 21st December, 1880.

SEA SIGNALS.

In Cliffe's "Book of North Wales," 1850, p. 118, it is stated "that this coast (Anglesea), is the resort in the breeding season of sea-birds, gulls, &c. No one, by order of Government, is allowed to shoot the birds, as in foggy weather they are invaluable to steamers and shipping, being instantly attracted round a vessel, or induced to fly up screaming by the firing of a gun. Captain Skinner's mail-packet was once saved in this way. The birds deposit their eggs in vast numbers on

the south side of the Stack rock, and are then tame. The gulls assemble here on the same night, on or about the 10th of February, when they make a great noise, and nearly all retire about the 12th of August." The Ailsa Crag, Bass Rock, and Skerries, are notable for sea-birds, now legally protected, and useful for sea signals. Their wholesale destruction is not only wanton, but mischievous. CHRISTOPHER COOKE.

London.

OBITUARY.

Frank Buckland.—Although he was not a member of the Society of Arts, the death of this well-known zoologist, on Sunday morning, 19th inst., will be deeply regretted by a large number of the members, who have always appreciated his appearance at the meetings of the Society. Francis Trevelyan Buckland was the eldest son of the Very Rev. William Buckland, D.D., Dean of Westminster. He was born on the 17th December, 1826, and was educated at Winchester and at Christ Church, Oxford. Having studied medicine in Paris and London, and served as house-surgeon to St. George's Hospital, he entered the 2nd Life Guards in 1854, as assistant-surgeon. He left the army in 1863, and for a time was a constant contributor to the *Field* newspaper and other periodicals. In 1866, with the late W. Pfennell, the first Inspector of English Salmon Fisheries, Mr. Buckland projected and started *Land and Water*. He conducted its intelligence in regard to sea and river fisheries and practical natural history, and contributed to it up to the very day before his death. In 1867, Mr. Buckland was appointed Inspector of English Salmon Fisheries, and his advice was sought by the Governments of Russia, Germany, France, America, &c., as well as by our colonies. In 1868, Mr. Buckland gave evidence before the Food Committee of the Society, and served on the Piscicultural Committee in 1869. In 1870, he was appointed Special Commissioner for the Salmon Fisheries of Scotland. He published a report on the Norfolk fisheries, which led to the Norfolk and Suffolk Fisheries Act of 1877. In the same year he was one of a Commission to inquire into the crab and lobster fisheries of England and Scotland, which resulted in an Act of Parliament for the protection of those molluscs. In 1877, he also served on a Commission of inquiry into the herring fisheries. In the next year he was engaged upon the Commission relative to the sea fisheries around England and Wales, a report upon which was published last year by Mr. Buckland and Mr. Spencer Walpole. The first paper contributed by Mr. Buckland to the Society, which was on "The Acclimatisation of Animals," was read on November 28th, 1860, and the last occasion on which he presided at a meeting was on April 25th, 1879, at the reading of Mr. Willis Bund's paper on "English Fresh Water Fisheries." He was then in feeble health, and was forced to leave the chair on account of illness. His Juvenile Lectures on "Birds, Beasts, and Fishes," in 1873, most successfully commenced these annual series of Christmas lectures.

GENERAL NOTES.

Royal Institution.—The lectures for the Friday meetings, before Easter, 1881, are arranged as follows:—January 21st, Warren De La Rue, Esq., D.C.L. F.R.S., Sec. R.I., "The Phenomena of the Electric Discharge, with 14,000 Chloride of Silver Cells." January 28th, Dr. Andrew Wilson, F.R.S.E., "The Origin of Colonial Organisms." February 4th, Dr. Arthur Schuster, F.R.S., "The Distances of the Stars." February 18th, Sir John Lubbock, Bart., M.P., D.C.L., F.R.S., "F Seeds." February 25th, Dr. J. S. Burdon LL.D., F.R.S., "Excitability in Plants and . March 4th, Sir William Thomson, LL.D., "Elasticity Viewed as Possibly a Mode of Motion 18th, William H. Stone, M.D., "Musical Pit Determination." March 25th, Alexander Buch F.R.S.E., Sec. Met. Soc. Scot., "The We Health of London." April 8th, Prof. Tyndal F.R.S. The lectures for March 11th and April yet fixed. Prof. Dewar will give the first of his Lectures (adapted to a juvenile audience) on on Tuesday next, December 28th, at three o'cl Royal Institution.

Trans-Australian Railway.—The colony o land seems likely, according to *The Colonies and* be the first to put into practical execution the long hope of a trans-Australian railway, which shall c northern with the southern shores of the island and bring the colonies within 30 days of Englar those which are now practically most distant fro the nearest in point of time, as they are by ri graphical position. The original route propos trans-Australian railway was from Port August Australia to Palmerston, the central port of th coast, adopting generally the line passed throu existing overland telegraph. The distance to be t a direct line from the northern terminus of the S tralian Railway to Palmerston is 1,400 miles, an able connecting links would have to be construct the existing lines in the adjoining colonies t direct communication between Port Augusta and and Sydney. By the new route now prop in fact, finally adopted by the Queenslan ment, the following advantages are secured. pal railway from Brisbane has just been in a north-westerly direction to Roma, a d 317 miles, and from this point to the nearest part of Carpentaria on the north coast is, in a direct li 850 miles. The line would almost touch on its w portant railway from Rockhampton to Emerald- the blanks to be filled up in the existing lines bet bane and Sydney are no greater than the links complete the chain between Adelaide and Sydney. latter are completed, there will be, on the complet now projected line from Roma to the Gulf of C continuous railway communication between the n southern coasts of Australia, having the additional of traversing the whole of the most settled district necting all the principal cities, except those i Australia. The Queensland Government has pas authorising the construction of the trans-continent and a syndicate has already agreed to perform the the condition of receiving, among certain other pr area of 8,000 acres of land for each mile of ra structed.

French Fruit and Vegetable Trade.—M. J some statistics, in a recent number of the *Jou* Central Horticultural Society of France, relating portation of fruits and vegetables into France in 1877, 1878, and 1879, as well as to the quantities the same years. The number of kilogrammes of o lemons imported amounted in round numbers to 37 1877, 34,000,000 in 1878, and 37,000,000 in 1879, nishing by far the largest amount. Of other fresh importations were 5,000,000 kilogrammes in 1877 in 1878, and 15,000,000 in 1879. Italy and Belgiu the largest proportion, but there is also a consid portation of this class of fruit from England, am 362,000 kilogrammes in 1877, to 107,000 in 18 42,000 in 1879. 4,000,000 kilogrammes were exp Italy into France, or double the amount of the year. As to the exportations from France, the q oranges and similar fruit amounted in 1877 4,000,000 kilogrammes, in 1878 to nearly 8,000,0 1879 to 2,500,000 kilogrammes. Of other fruit amounts exported from France to England wer upwards of 19,000,000 kilogrammes, in 1878 t 24,000,000, but in 1879 only 13,000,000 kilogra potatoes, the quantities exported from France int were, in 1877, upwards of 103,000,000 quintals more than 107,000,000 kilogrammes, and in 1879, quintals.

. OF THE SOCIETY OF ARTS.

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DAY, DECEMBER 31, 1880.

tions for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

EDINGS OF THE SOCIETY.

JUVENILE LECTURES.

st of these lectures, on "Animal ce," was delivered by Mr. G. J. , F.R.S., on Wednesday evening, 29th ie lecturer devoted the whole of his the consideration of the habit of Ants, iged his subject under the following seven I. Sense of sight, hearing, and smell. e of direction. III. Power of communi- IV. Powers of memory. V. Affection nosity. VI. General habits. VII. General nce. Each of these divisions was illustrated dotes, related on the authority of trust- observers, such as Huber, Lubbock, Belt, Lipscomb, Moggridge, and others. The lecture will relate to the intelligence of the animals.

CANTOR LECTURES.

POINTS OF CONTACT BETWEEN SCIENTIFIC AND ARTISTIC ASPECTS TTERY AND PORCELAIN.

Prof. A. H. Church, M.A. Oxon., F.C.S.

II.—DELIVERED NOVEMBER 29TH, 1880.

Enamels, Iridescent and Metallic Lustres, and Colouring Substances.

the form, texture, and colour of unglazed whether the body be merely drawn together as in the softer terra-cottas, or whether it or less vitrified, as in the "red opaque of Böttcher and Elers, and the black of Wedgwood—from considering the e elements of the bodies, we pass natu- he various modes of enriching the surface lases and enamels supply. We shall d this part of our subject more thoroughly, if we classify the constituents of all ceramic wares, not of the glazings and slips only, but of the bodies also, somewhat after the following fashion, noting the characteristic property which each separate constituent does, as a rule, confer upon the product to which it has been a contributory:—

i. *Refractory.*	ii. *Hard.*	iii. *Fusible.*
Alumina.	Silica.	Lead oxide, Potash, Soda, Boracic acid, Lime, Baryta.
iv. *Colorant.*	v. *Lustrous.*	vi. *Opaque.*
Iron, Copper, Cobalt, Manganese, Chromium, Antimony, Nickel, Uranium.	Gold, Platinum, Silver, Bismuth.	Barium sulphate, Bone-ash, Binoxide of tin.

But no sharp distinction can be drawn between these six classes, if we include in our view all possible combination of them one with the other; or if, on the other hand, we exclude completely from a ceramic composition one or more of the chief members of the first three classes. Lime, for example, usually aids in the fusibility of a body or glaze, forming with silica a silicate, which melts without difficulty. But nothing—not even alumina—is so refractory as pure lime, from which crucibles for use with the oxy-hydrogen blow-pipe, and for the fusion of platinum, are made. Again, iron is set down as giving colour, but it unites with silica and small quantities of lime or alkaline oxides to form a kind of half-glaze. This Japanese bottle shows three conditions of surface on unglazed brown stoneware; a surface on which an iron ore, containing nearly 90 per cent. of oxide of iron, has been spread; and a region near the mouth, to which some small sprinklings of felspathic clay have been further added. The gloss of the three surfaces has been progressively increased, while the microscopic examination of the glazed portions indicates the cause of the beautiful colours and textures which have been formed. One of the crystalline kiln-products thus formed within the glaze is a copper-coloured complex ferric silicate, which is a very common constituent of ferruginous glazes. Some bricks offer instances of such iron glazes, often produced irregularly and accidentally. The so-called Samian ware, with its sealing-wax red glaze, and the black Greek vases, show what colour effects are producible by fine compositions rich in iron.

In studying the relations of glazes and enamels to the decorative effects which they produce, it will be useful to consider these three qualities:—

(*a.*) Transparency, translucency, or opacity.
(*b.*) Colour, whether below, in, or above the glaze; its distribution; its quality.
(*c.*) Lustre; its quality and position.

Keeping these points in view, it may not be without use if I give you a brief account, arranged in some sort of chemical, historical, and artistic sequence, of the chief glazes and allied preparations, which we must consider if we would properly

understand the decorative results achieved by their use.

Soda Glazes.—Although early felspathic glazes owe their vitrescence to potash or soda, yet the alkaline glazes from "natron," the native carbonate of soda from Egyptian soda-lakes, from the mixed potash and soda salts of burnt seaweed, and from the potash salts of burnt land-plants, are earlier in date. Babylonian and Assyrian enamelled bricks (*circa* B.C. 700 — 600) contain, like those of Egyptian origin, silicate of soda as the basis of the glaze, with copper, iron, antimony, and even lead for colouring (the last for increasing the fusibility also). Old Indian enamels, dating at least from the thirteenth century of our era, contain a silicate of soda and copper, yielding a fine turquoise colour; and also another soda silicate, tinted by oxide of cobalt. Soda glazes, when not too alkaline, possess the merit of being unaffected by the water, the carbonic acid, and the sulphuretted hydrogen, which, singly or conjointly, tend to disintegrate, or at least to roughen and tarnish, many glazes containing lead. And it is by the aid of soda alone that certain hues, as that of the turquoise, can be developed.

Potash Glazes are mainly those which are formed from felspar and from china-stone, which contains both felspar and immature kaolin, from which by no means all the alkali has been eliminated. Of these glazes I shall have something to say further on in the course, when speaking of hard porcelains. But potash glazes, properly so-called, can hardly have originated otherwise than by burning land-plants with or on sand, by which glass, the typical glaze, was first produced.

Lead Glazes can, in England, be traced back to the first or second century. Several Roman lamps show a green glaze, containing much lead, coloured by iron and copper; one found at Dorchester, Oxon, is in my collection. All the early mediæval tiles in which England excelled are glazed with lead. Litharge (PbO), red-lead (Pb_3O_4), white-lead ($2\ PbCO_3, PbH_2O_2$), and lead glass were all, and are all, employed; to these materials must be added galena, the native sulphide of lead. A previous "fritting" of the plumbiferous substance is advantageous; first, in order to secure the combination of the lead oxide with the china-stone, flint, or other silicious materials of the glazing mixture; second, to allow of the lead being lowered to a minimum amount; third, to increase the hardness and insolubility of the glaze. Lead certainly developes (as does zinc oxide also) the beauty of some of the enamel colours, and it would be hard to exclude it from all glazes, although borax and boracic acid, the chemical function of which is different, may replace it to some extent, and in many instances. Two marked peculiarities belong to lead glazes—one of these is the yellow tint (fused lead protoxide and highly plumbiferous silicates are yellow), which glazes containing much lead give to white clays, an effect seen on many early tiles and other specimens of early English pottery; and the other peculiarity of lead glazes is the iridescence, often beautiful, caused on their surface by their commencing decay.

Tin Glazes, often called enamels *par excellence*, owe their gloss, generally at least, to lead, the tin binoxide merely imparting whiteness and opacity. Babylonian and Assyrian specimens are known, but the use of tin seems to have been lo times, and the lack of acquaintance with perties, or perhaps rather of the oppoı securing a supply, seems to have caused a of its employment. The tiles of Mahom (A.D. 707) contain neither lead nor tin. Bı ferous glazes were introduced into Spa Moors in the thirteenth century; they in Italy as early as 1400. There is great hardness and coldness when tin glazes aı upon; a subsequent transparent glaze used to obviate this defect; but they ar for highly pictorial and precise work. A lies in the ease with which these tin glaz detached from the porous bodies to whicl usually applied. This tin enamel ofteı too much tin oxide—sometimes twice as the newer than in the older specime consequence of the difference is seen in t the colours lie on the surface when it is r but in the opposite case they work into tl during firing, and so produce a softer ef works in basso and alto relievo one w said that tin glazes were ill-adapted, l been for the works executed in this n Luca della Robbia, the Florentine scu Florence one forgives the glitter and these works, the rounded obliteration c and finest thought and expression of Yet his terra-cottas, when not covered b "majolica cream," if more injured, ar lously finer.

Smears are closely allied to glazes, chemical composition and in decorati but their appearance, if less even, is r quiet and delicate. It is often noticed, acquire a partial or slight gloss, th volatilisation of alkalies or lead from ot coated with glaze, and fired in the same sometimes the same effect is produced w during firing, throw up to their surfac their more finely comminuted, or more f stituents. "Smearing" is now empl considerable extent, as affording a use tion through the kind of half-glaze produces. Red lead, china-stone, sal bone-ash, nitre, litharge, and flint, ad or more of them together, or, in s singly, are the chief constituents c and are applied as a kind of wash on of the saggers in which the pieces "Flows" resemble smears; additional used in them are lime, alum, whiting ammoniac.

Passing from glazes to colouring we find that the preparations employed decoration may be classified rather manner of application than by theiı composition, although this has to b according to the material to be painte temperature of the firing. Some colo the body, encaustic; some are on the under the glaze; some are in the glaze, are over the glaze. This list by no mean the series, for we have colours placed and others on enamel. A very large colour effects are producible by the posi colouring substances, while nearly as be said of the results attainable by v quantity and nature of the associated c

of the ceramic pigments, whether these constituents be fusible or refractory.

Encaustic colours were used by Wedgwood, in his classical paintings upon basaltes and coloured clay bodies; they consist of slips of opaque clay, to which various colour oxides, such as those of cobalt, chromium, and iron, are added. They are employed in *pâte sur pâte* decoration, and very extensively in paving tiles and mosaic tesseræ. They are applicable to opaque bodies, and to those that are translucent; to those fired at low as well as at high temperatures.

Enamel colours illustrate another way of employing the colouring power of certain metallic oxides; in these there is a glass of silicate of cobalt, silicate of iron, &c., or of borate. China clay is mixed with some, and with some felspar; some are nearly pure silicates. Pure oxides, as that of cobalt, do not belong here, and such preparations are mainly used for underglaze painting, on such bodies as need a high temperature for firing.

Some interesting contact points between chemistry and art come out, on the consideration of the several metals to which the colours of pottery and porcelain are due.

Iron yields a fine red when fully oxidised, and then neither alkali, nor lime, nor barytes, nor magnesia, nor a very high temperature, impair its beauty. Much of the Kaga ware of Japan, and the underglaze red of certain Chinese porcelains, illustrate this point. Then the silicate and borate of protoxide of iron are green; the mixed oxides brown, or even black. But much depends upon the form in which the iron is introduced, much upon the temperature, and much upon the fuel. The effects of alkaline bases on iron hues have been pointed out in the previous lecture; an instructive xample is furnished, as I pointed out many years go, by the red chalk of Hunstanton, in Norfolk. hen strongly ignited, this becomes an olive green, ring to the formation of the compound—Fe_2O_3, O.

Cobalt, from which the majority of our blues are rived, is difficult to manage, both in hue, depth, d brushwork or application. The bold pulsating e of choice specimens of old Chinese blue and ite is perfect, so is much of that found in sian, Damascus, or Rhodian *faïence*. When cobalt contains nickel, or manganese, or iron, usual impurities, it is greatly injured; at t, its hue becomes so modified towards grey, go, or purple, as to lose its distinguishing ity.

Copper, though of a rich green in the form of ate, becomes, by reduction to suboxide, able of yielding a characteristic red. Pleasing cts are produced by blowing a reducing ture, in spray, upon the turquoise green mel of certain cupreous preparations.

Manganese may yield a puce, a violet, or a plum ur. It probably does not exist in ceramic ments, either as MnO_2, or salts of MnO. Its uty is frequently dulled by ferruginous imities, sometimes by baryta or copper. With mium and cobalt it yields a black.

Chromium is known to exist in two conditions of lation; one bluish-green, the other yellow; n bases are abundant, it more readily tends ards the latter state. But chromium yields, in presence of tin (of stannic oxide), a beautiful rose colour, which is generally known as "pink colour," and has been largely used in ceramic decoration. The peculiarity of the composition of this colour lies in the very small proportion of chromium which it contains.

Almost every metal belonging to what is called the "heavy" class, may be used for colouring—the alkaline metals, the earthy, and the alkaline-earthy, are destitute of this power.

After colours come lustres. They do not necessarily depend upon the actual metallic condition of certain constituents on the surface. Nor do metals, even if free, that is, in their proper metallic condition, invariably present a lustrous appearance. The metal employed for lustring is bismuth, patented by Brianchon, and imitated at Worcester and Belleek; it gives a beautiful iridescence, which has been too lavishly used—smeared over everything—or it would be more appreciated. Copper and silver give lustre to Italian wares, decorated at Gubbio, Pesaro, and Deruta, and also to some wares produced in Persia and in Spain. In the last half of the eighteenth century, at Brislington, near Bristol, and in Staffordshire, by Wedgwood, lustres fair in tone, but unsuccessful in decorative treatment and association with other colours, were made. Gold was used by Wedgwood, not only for ordinary gilding on his wares, but also for staining them and lustring their surface. Platinum was employed by several potters of the eighteenth century, in Staffordshire. Messrs. Lockett and Co., of Longton, in 1862, manufactured many lustred pieces. Carrocci, of Gubbio, now prepares a beautiful ruby lustre; and for some years past, Mr. William de Morgan, of Great Cheyne-row, Chelsea, has produced both ruby and mother-of-pearl lustres of great beauty. The designs on his pieces are so fresh and so good that one cannot but rejoice in this combination of remarkable excellence in drawing and chromatic effect. More recently, Mr. George Maw, of Benthall-hall, Broseley, has turned his attention to the production of lustres. His ruby lustre frequently (in fact, nearly always) possesses that quality of transparence which marked the Gubbio ruby, and which modern lustres nearly always miss.

In drawing your attention to the specimens on the table, some of which are old, and many new, some European and some of Eastern origin, it may be useful if I point out, not only the lessons which individual examples may teach, but a general difference of character or feeling between modern work, and much European work generally, on the one hand, and old and most Eastern work on the other. As such general difference lies almost wholly in the glaze and its associated chromatic elements, this place seems to be the most appropriate for its consideration. Modern work is prosaic, laboured, uninteresting. If it be learned, it is not learned enough. If its decoration were the outcome of nothing more than unspoilt tradition, the decorative result would be more satisfactory. But the obvious striving after effects and qualities which are yet imperfectly realised, pains the artistic sense of those persons who are familiar with the productions of other times and other countries. If one examines a modern piece of English turquoise glaze, a very noticeable defect obtrudes itself on the eye at once. The colour is staring enough,

strong enough (what the French call *voyant* and *criant*), but muddy withal; you cannot look *into* it. If a mottled, or flooded, or varied glaze be attempted, the result realises the mottling or other peculiarity of the Chinese original distinctly, but misses its easy, careless grace, whereby art conceals artifice. Of course all modern and all English work is not amenable to such criticism. For instance, Mr. W. De Morgan's Persian tiles are worthy of unqualified praise. On the red body beneath, a white slip or wash is placed, which, while illuminating the nearly transparent turquoise, puce, and blue glazes above, does not reveal itself, nor disclose the mechanism of the final success. Here, too, the design of the ornament, the quality of the hues, the degree of gloss, and the blending of contiguous colours are all just simply perfect. And it is not difficult to discover similar meritorious elements in the productions of other factories. Here is a specimen of modern Hungarian earthenware, in which, upon a softly mottled ground of dove-colour and crimson, a graceful network of golden foliage is spread. And these beautiful tile-pictures, by Messrs. Simpson, of St. Martin's-lane, illustrating both underglaze and overglaze painting, show the association of high artistic power with the frank recognition of the nature of the materials, and the uses to which the objects are to be put.

A few words must now be said about the specimens of glazes and colours, which are on the table. Ferruginous glazes are shown in these Japanese bottles, and in this tyg of the 15th century, from the ruins of the Blackfriars monastery in Bristol. This English mediæval jug shows a green glaze, due to a silicate of lead, copper, and iron, This large mottled Chinese dish, and this octagonal old Staffordshire tortoise-shell plate, owe their colours to manganese, copper, antimony, and iron, the glaze in both cases being rich in lead. A milk jug, of about 1750, shows how a lead glaze brings out the colours of the two clays, one white, the other buff, from which the vessel has been fashioned. This old Staffordshire agate-ware sauce boat exhibits the softening, because solvent, effect of a lead glaze upon the irregular patches and strings of parti-coloured clays, tinctured with cobalt and iron, of which it has been formed. A Japanese plate, by Kenzan, of about 1730, exhibits the effects of a vitreous glaze upon a rough clay, and also affords a good example of glaze upon a white slip. Another bit of Japanese ware, quite modern, is of buff clay on white; the simple decoration is in delicately pencilled white clay, the glaze just developing the colour of both body and design, and not obtruding itself by excessive gloss. Here is a bowl of old Kaga ware, where the brown body tones down the brilliancy of all the enamel colours, save the opaque blue, with which it is decorated. Here, again, is a tea bowl, where the one point noticeable is a rich brown glaze, free from lead, but of absolutely perfect gloss. Looking into this glaze, we see its tones are beautifully varied from base to lip, and that there is no monotony, as of textureless varnish, anywhere in its substance. A white, porous clay bowl, with cinque-foils in manganese, purple and dim undulatory lines of cobalt blue, both underglaze, shows the penetration of these colours into the body, and how the glaze has softened and united the whole into Often, in these Japanese wares, we may play of colour and texture obtained simple means as glazing with a colou one part of a vessel, leaving another part coating another part with a white enam and tincturing a fourth part with son colour. This treatment has been ado this vessel, shaped as a leaf, and lends i peculiar appropriatenes to the conven presentation of the texture, substance, an veins, undulations, and margins. Of ot on Japanese wares, here are half a doz teristic examples, each capable of teachi lesson to Western potters.

These examples of Persian and Rho and their imitations are most instruc show, above all things, how useless it is the imitation of an effect by means of pr materials having wholly different ph chemical characters. Does this modern Persian *faïence* realise any of the beau original? Is it not a ridiculous caricatu at the carefully painted imitation of th or spreading at the edges of the colours. the opaque, uninteresting body. Here i downwards into the clay, and no diss wards in the glaze.

The stanniferous enamels of Italy a their best in such examples as this d Caffagiuolo; at their worst in this plate origin of about 1710. Bristol, Live Dutch tiles of the eighteenth century teach us useful lessons, especially whe pare them with these works of Deck a (both of Paris), in which the stannifer and the enamel painting which it carrie at the same time.

MISCELLANEOUS.

REPORT ON TWO EXPEDITIONS TO

By Captain R. F. Burton.

The following lines contain a concise acc circumstances which, during the last three connected me with the Egyptian province, H. H. Ismail I., honoured me, th Frederick Smart, with an invitation to visit to lay before him certain details which I h concerning mineral wealth in N. Western A

I left Trieste on March 3rd, 1877. A sm tion was at once prepared: it set out for El on April 2nd; and returned to Suez on During those 18 days we found, by exa sites, that the country had been extensi while a larger area remained untouched. home specimens of gold, silver, galena, zi sulphur, iron, and other metals. H.H. pleased, and promised me, in presence of Mr of other persons, either a concession or a 5 per cent. on gross produce.

Returning from the first expedition I had to recommend:—1. Mr. Charles Clarke (for the rank of Bey. 2. Lt. Hasan Effend Lt. Amir Effendi Rushdi for a step in pr also solicited a small life-pension for Haji W

of Zagazig, who had drawn my attention to the mines of El-Madyan.

On October 9th, 1877, I again left Trieste. After some delay at Cairo, the second expedition set out from Suez on December 11th; and returned on April 12th, 1879. During this journey of four months, Mr. Marie, the engineer sent out by H.H., collected some 20 tons of specimens; and I was directed to have them assayed in London, while Mr. Smart was charged, in my presence, with furnishing the necessary funds. The analysis was duly made and the printed report was forwarded to Egypt; but funds were not forthcoming, and the consequence was, that I was compelled to supply them.

Returning to Cairo I renewed my request touching the pension of Haji Wali; I again submitted for promotion the names of Mr. Clarke and Lt. Amir Effendi Rashdi; and I added to them that of Ahmed Kaptàn Musallam. Moreover, for the better government of the province (El-Madyan), which is about to assume new relations with Egypt, I had the honour to propose—1. That Sayyid Abd el Rahim, accountant of the Fort El-Muwaylah, be raised to the rank of Nàzir, or commandant. 2. That Mohammed Shahadeh, Ex-Wakil of El-Wijh be made commandant of that fort. 3. That some token of H.H.'s favour be conferred upon Sheykh Alayàn Bin Rabi of the Huwatàt tribe, Sheykh Furayj of the Huwatàt tribe, Sheykh Hasan ibn Sàlim El-Ukbi.

For the safety of Egypt and Europe I also recommended that the quarantine establishment be re-transferred from Tor harbour to El-Wijh.

Since leaving Cairo (May, 1878), I have repeatedly written concerning the administrative measures to be adopted before the country can be regularly exploited, but hitherto my representations have remained unnoticed.

I now return to the mines. The result of the assays made by three several establishments is so far encouraging that Dr. Percy, one of the highest authorities on metallurgy, declares "These indications of the presence of the precious metals certainly justify further explorations." Such exploration I am prepared to undertake.

I left Trieste on December 5th, 1879, and came to Cairo ready for a third expedition. This time the conditions of exploitation are more favourable, as I have no longer to seek for the sites which are best fitted for beginning operations.

It is, however, evident that no syndicate, no company, would risk capital upon a project, however promising, without the prospect of enjoying the fruits of success. Certain capitalists in London are willing to aid me, but it will be upon conditions that a formal contract or concession be granted to me.

The Nouveau *Règlement sur les mines de l' Empire Ottoman*, inserted in the Tranzimat (Constitution) and bearing date July 17th, 1861, authorises this concession, and lays down all the legal conditions regarding royalty and other matters.

An objection might be raised that the *Règlement* applies to subjects of the Porte. But, firstly, there are precedents for extending the privilege to foreigners; for instance, in the case of the minerals about Sidon. Secondly, this proviso, made for Turkey proper, is not applicable to Egypt, where there are now international tribunals. Disputed questions of royalty, jurisdiction, &c., could be settled by arbitrators, the latter nominated in equal numbers by the Government and the company.

The public will observe that I am not acting as one who seeks to receive favours from Egypt. On the contrary, I propose to develop a province which has been for centuries, and which still is, a howling wilderness, occupied by a few hundred Bedawin. I propose to benefit Suez and the adjacent parts of Egypt by creating an industry and a traffic where there is now nothing of the kind. Lastly, I propose adding to the resources of H.H.'s Government, by making over to it the legal share of whatsoever profits may accrue from the exploitation of El-Madyan.

Under these circumstances I have a claim to expect the realisation of a project whose views are of the most legitimate. And the first steps would be—1st. A contract or concession drawn up in due form. 2nd. An authority to carry out the measures proposed for the government of the province; especially the rewards due to the military officers and the civilians who assisted in exploring El-Madyan.

THE NATIVE SILKS OF ASSAM.

By C. G. Warnford Lock.

The native silks of Assam, known as *Eria* and *Muga*, are the produce respectively of *Attacus Ricini*, and *Antheræa assama*, and *Antheræa Mezankooria*.

The *Eria* worm is so called from the local name of the castor-oil plant (*Ricinus communis*), on which it is almost exclusively fed. It is reared entirely indoors. The duration of its life varies with the season: in the summer, it is shorter, and the product is both better and more abundant. At this season, 20 to 24 days elapse from the date of its birth to the time when it begins its cocoon, 15 days later the moth is produced, in three days the eggs are laid, and in five more they are hatched, making the total duration of a breed 43 days. In winter, its life extends to nearly two months. Seven breeds are reckoned upon annually. For breeding, the natives select cocoons from among those which begin to be formed in the largest number on the same day. Those containing males are recognised by a more pointed end. On the second or third day after the cocoons have begun to be formed, they are put into a closed basket, and hung up in the house, out of reach of vermin and insects. Twenty-four hours after the moths have been produced, the females are tied to long reeds or canes, 20 to 25 to each, and these are suspended in the house. The eggs laid during the first three days alone are kept; they are tied up in a piece of cloth, and hung from the roof till a few begin to hatch; these eggs are white, and resemble turnip seed in size. When a few of the worms are hatched, the cloths are put on small bamboo platters, and here they are fed with tender leaves. After the second moulting, the worms are removed to feed on bunches of leaves, suspended a little above the ground, and a mat is spread beneath to catch those which fall. When they have ceased feeding, they are placed in baskets filled with dry leaves, amongst which they form their cocoons. In four days, the latter are complete. A selection having been made for the next breed, the remainder are exposed to the sun for two to three days, to destroy the vitality of the chrysalis. The cocoons are next generally put into water containing potash (wood-ashes), over a slow fire; when removed, the water is gently squeezed out. At other times, they are massed together for some days with *amritu* (? *Carica papaya*) or *madhu* fruit. The object is the same in either case, viz., to facilitate the drawing of the silk. The cocoons thus treated are taken one by one, and the silk is placed within the thumb of the left hand, whilst the right is employed in drawing out the silk. Any inequalities that may exist are reduced by rubbing them down between the thumb and finger; the same process serves for joining on new cocoons. The thread is allowed to accumulate in quantities of about half-a-pound; these are afterwards exposed to the sun, or placed near a fire, till dry, when they are wound up into skeins. The silk is then ready for the weaver. It is the coarser of the two kinds, and none of it ever finds its way into Bengal.

The *Muga* moth is found wild in the jungle, but all the silk produced by it is from domesticated worms. They are reared on trees in the open air. There are

generally five breeds in a year, viz., January to February, May to June, July to August, September to October, and November. The first and last yield the best crops, as regards both quantity and quality. Constant watching of the tree is necessary. By day, crows and other birds pounce upon the worms, and devour them. By night, bats, owls, and rats are very destructive. Numbers of the caterpillars are destroyed in the more advanced stages by the sting of wasps, and by the ichneumon insect, which deposits its eggs in the bodies of the worms. The latter thrive best in dry weather, but a very hot sunny day at the moulting time proves fatal to many. Indeed, at this period, rain is considered very favourable; and even thunderstorms are not injurious, as they are to the mulberry worm. Continual heavy rains do mischief by sweeping the worms off the trees; but showers, however violent, cause no great damage, the worms generally taking shelter under the leaves with perfect safety. During moulting, the worms remain on the branches, but when about beginning to spin, they come down the trunk. Bunches of fresh plaintain leaves are tied round the trunks at some height from the ground, in order to arrest their progress. The worms are then collected in baskets, which are put under bunches of dry leaves, suspended from the roof of the house; they crawl up into these, and there form their cocoons. The total duration of a breed varies from 60 to 70 days; the period is thus divided:—4 moultings, 20 days; from fourth moulting to beginning of cocoon, 10 days; in the cocoon, 20 days; as a moth, 6 days; hatching of the eggs, 10 days; total, 66 days. The chrysalis not being easily killed by exposure to the sun, a number of cocoons are placed upon bamboo stages, and covered with leaves, whilst a quantity of dry grass is ignited below them, and in a short time destroys them. The cocoons are then boiled for about an hour in water containing potash (the ashes of mustard and other plants). When taken out, they are laid between folds of cloth. The floss is removed by hand, and the cocoons are thrown into hot water. The instrument used for winding off the silk is the roughest imaginable. A thick bamboo, about 3 ft. long, is split in two, and the pieces are driven equally into the ground about 2 ft. apart; over the interior projection of one of the knots is laid a stick, to which is fixed, a little on one side, a round piece of plank, about 1 ft. in diameter. The rotary motion is given by jerking this axle, on which the thread rolls itself. In front of the vessel holding the cocoons, a stick is placed horizontally for the thread to travel upon. Two persons are employed—one attends to the cocoons; the other jerks the axle with the right hand, and with the same hand directs the thread up the left forearm, so that it is twisted in coming down again towards the hand, while the left hand conducts the thread over the axle. The Assamese consider it a good annual return if an acre of trees support 50,000 cocoons, yielding upwards of 24 lb. of silk. It must be very profitable, as 1,000 cocoons are reckoned to afford 6 to 8½ oz. of silk thread, selling at 10s. to 12s. a pound. The labour and expense of maintaining a plantation of the trees is very trifling.

Two kinds of silk are distinguished by the natives as the production of the *Muga* worm—*muga* and *mujankuri*, their difference being attributed to the trees on which the worms are fed; but naturalists have determined a specific difference in the worms themselves, calling the former *Antheræa assama*, and the latter *Antheræa Mezankooria*. The *Muga* worms feed chiefly on the *Sum* tree (? *Artocarpus chaplasha; Tetranthera lanciolata*); *mujankuri*, from those fed on the *Adakur* tree (? *Tetranthera quadrifolia*). The latter is whiter and better than the former. Some of the silk thread produced in Sibsagar sells for as much as 36s. a pound. Lakhimpur, in 1871, exported 11¼ tons of *Muga* silk thread, valued at £6,090.

The reader may refer to the *Journal*, May 9th, 1879, for further information on Indian wild silks.

CULTIVATION OF THE FIG IN [

The United States Consul at Smyrna st[
Aidin district is the only one which prod[
exportation. The fruit will grow any[
neighbourhood of Smyrna, of a good qu[
sumption, in a green state; but the A[
unique in its climate and soil as being favo[
proper curing of the fig. The thermo[
falls below three or four degrees under fr[
and in the summer seldom rises above[
Fahrenheit in the sun. In Aidin, the[
generally wet, the dry weather commencin[
continuing till the end of October. Any ra[
of July, or during the month of August a[
when the fruit is under the process of dr[
the quality, by causing it to burst, hard[
gives the fig a dark colour, and spoil[
quality. Heavy dews will cause the sam[

The fig tree will grow in almost any soil;
soil is, however, preferable; but to produc[
dry well and please the merchant, the soil
of a good depth, and of a rich, light, sandy
if the weather be favourable, will produc[
a white thin skin, and of the finest qu[
planting, the ground is well ploughed[
times to a good depth, well fertilised, an[
all weeds and extraneous roots. The fig[
from slips, selected with as many fruity[
sible. To form a tree, two slips are pla[
apart, and then joined at the top. [
planted in rich soil, should be place[
feet apart, and for poor soil about 25 feet
each other. The cuttings are planted in[
March, two in each hole, at about 9 inc[
apart at the root end, and during the [
trees, the ground is ploughed up two o[
during the winter or spring, and the s[
them is used to cultivate cotton, sesame, o[

The fig harvest generally lasts about s[
when the fig is ripe, it falls of its own a[
tree. Women and children are employed[
fruit into small baskets, to be conveyed to[
garden well exposed to the sun, where t[
on a bed of dry grass, or matting, singl[
on the top of the other, and are turned o[
in order to get every part of the fig e[
sun. After a few days of this exposu[
which are sufficiently dry are selected f[
and divided into first, second, and third[
being taken not to dry them too much. [
sent to Smyrna, where they are assorted a[
shipment.

On arrival at Smyrna, they are conve[
bazaar, or market place, where the mer[
early next morning to effect purchases.[
belonging to each individual owner are[
amined, each purchaser giving his own p[
is nearly always employed as an intern[
merchant, on payment to him of 2 pe[
value, the amount being ultimately re[
seller. A seller is but seldom the owne[
latter being generally represented by a Je[
merchant, at an exorbitant charge of 7[
commission. The figs are then, after [
veyed to the packing establishment, to un[
lation and putting into boxes; the sack[
out on the floor in a square heap, and o[
squatted rows of women and girls, empl[
twisting round each fig two or three tim[
forefinger and thumb, to render it soft, a[
required oblong form. On the heap are
baskets, into which are thrown separatel[
second qualities to be used for packing; at l[
of the whole mass is worthless for puttin[
and, during the first process, the inferior
up and thrown in a separate heap. Und[

otted figs, and such as are burst, come under this gory, and are packed, or rather preserved, promis- ssly in small boxes, and labelled "Figs for family " Sometimes, when the parcel is unusually good, e qualities are selected instead of two. The figs are laid on long benches, at which are seated the ticed packers. Each man has a box before him, and tly and dexterously the figs are placed alongside other in rows, the rows varying in number accord- o the depth of the box, the flat ones, which are in general use, requiring but two. This mode of pack- s called "pulled." Above all, a row of "layers" nplaced, to show the figs to advantage. The "layers" worked out by means of both hands, and laid de by side in parallel rows. Of late years, " throughout the boxes have come into great and nearly all the best qualities are packed ay. In packing, the fingers are now and then o a bucket of sea-water, to ease their working; come thus moistened with salt water, which has the effect of hastening their sugar- boxes are again passed on to the women, te the process by placing laurel leaves be- ipper rows, before the final nailing down ig off by the carpenter. The packages used ous dimensions and forms; at one time all d to the United States were placed in aper boxes, but of late years flat wooden ing extensively shipped. Very few drums, their way to the English market, to which alities are usually sent. America consumes the superior qualities, though the demand s now increased. Small canvas bags are now with much success, and in fact, every season elty in the style of packing may be The refuse, or "naturals," are put into large barrels, and shipped to England, Egypt, and Turkey, the high rate of duty in ntirely excluding those inferior figs from the

PANG-CHONG.—A CHINESE REMEDY FOR CUTANEOUS DISEASES.

pharmaceutical products of China and Japan a interesting field for experiment into their sitions and probable values. From time to time, rugs from various parts of the world are brought ropean notice, and of late years many have been to be of great practical usefulness, and are now led amongst our important medicines. Though mber and variety of the substances used in medi- y the Chinese and Japanese are very great, and h very complete collections of the drugs of these ries have been exhibited at the various exhibitions, ly at the last Paris Exhibition, little has been d towards introducing them in quantity for trial dical men in this country. Something, indeed, lone a short time since in this direction by Mr. as Christy, who introduced a number of raw able products used as drugs in Japan; these were fied and described in a series of notes published in harmaceutical Journal at the time. Mr. Christy ite recently received a consignment of a drug is reputed to be very valuable in China, for e of certain skin diseases; it is known under the f Tong-pang-chong, and is said to be produced nt growing in Siam, whence it finds its way to In the Kew report for 1877, where the sub- referred to, it is stated that the chemists in Kong say that they can procure an almost l supply, and even hint at getting and growing t there. From information gathered from fore the report was written, and from com- f a very small sample sent to this country with s, which appeared to be identical, contained in the Kew Museum, there seems but little doubt that this interesting and peculiar remedy was produced by an Acanthaceous plant, known to botanists as *Rhinacanthus communis*. Whether the material now in Mr. Christy's hands will prove the accuracy of this preliminary determination remains to be seen, as also the question of the actual efficacy of the drug itself.

WINES OF CHILI.

The vine was introduced into Chili by the Spaniards, soon after their conquest of the country, but although its culture quickly extended over the central and southern provinces, it is only within the last twenty years that viticulture has been systematically carried on. The following particulars by Mr. E. Seve, of Valparaiso, are taken from the *Journal of Applied Science*:—

A large portion of the finest sets or cuttings of Europe, and chiefly those of Burgundy and Bordeaux, were imported. The production of wine consequently increased, and its use at table became general. The introduction of these French vines led to the Chilians abandoning much of their former culture and mode of wine-making, and adopting those of the country from which the vines were imported. The result of these efforts are now apparent. At present, in many of the provinces, especially of the centre, sound wholesome wines of an excellent quality, in a certain degree compete with similar products of the old world. Wine-making in Chili is at present a considerable and very profitable industry, and forms a principal source of the riches of the country. By the great diversity of its climate, the nature and topographical configuration of its soil, Chili offers the best natural situations for nearly all the classes of renowned wines.

The region suited for the vine in Chili extends from the north down to Biobio in the south. But in the south, the humidity of the climate will not allow the grapes to ripen without artificial means.

The vines are distinguished in the country either as Chilian or French. The vines in the country consist of the cock grape (*uva de gallo*), the white and black muscat, the black San Francisco, and the common black. The Chilian vines are met with chiefly in the South and the North. The French vines have been introduced almost entirely in the central regions, where they constitute extensive vineyards. The principal French varieties introduced and grown on a large scale are the Pinots, Gamais, Sauvignons, Cabernet, Malbeck, Cot-Rouge, Meunier, White Semillon, Folleblanche, &c. The Chasselas of Fontainebleau are met with on all the trellises of the gardens, the orchards, &c. In the greater part of the French vineyards in Chilli we find all these varieties very often mixed, conditions most unfavourable for wine-making, as the grapes do not ripen at the same time.

The choice of vines, and their suitability to soil and climate, so as to make a certain class of wine, is a question badly understood in Chili, and to which the attention of the vine growers should be directed, as upon the solution of this point depends in a great degree the future of the Chilian wine production.

The Chilian irrigated vines receive neither care nor culture during their growth: indeed they are hardly ever pruned after bearing.

The French vines, having more attention paid to them in culture, the soil is kept porous and in good condition, and the roots are cared for during the progress of vegetation. Thus, in the same climate, under the same conditions of soil, in the same vineyard, the French vines will ripen their fruit fifteen days to three weeks before those of the vines of the country, and give a much more abundant produce. The indigenous vines, treated after the French method, improve greatly. This fact is a striking example of the influence of culture on agricultural plants.

Up to the present time no serious malady has attacked the vines in Chili. The oïdium has been long known there, but the climatic conditions are unfavourable to the propagation of this parasite. After some days of rain in the close of November a little damage has been done. In the Argentine Republic, about Mendoza, where the vine is largely grown, there have been serious complaints for some years of damage done to the vines. But it may be remarked that on the sides of the Cordilleras facing Santiago the rains occur in summer, while in the central regions of Chili they occur in winter. The phylloxera, fortunately, is not known in Chili, and the Government have forbidden the introduction of French cuttings, with the view of preventing the devastation.

The duration of the vine in Chili is considerable; vineyards of fifty years old are by no means rare. The principal kinds of wine made in Chili are as follows:—Those known as Burgundy and Bordeaux in the country are the produce of French vines, and the manufacture is carried on on the same principle. White wine is but little drank in Chili, hence nearly all the wine made from the French grapes is red. The quality of the white wine is, however, superior to that of the red.

French vines, under good conditions, well cultivated, will yield 100 to 120 hectolitres of wine to the hectare; it is sold in the first year at 40 to 50 centimes the litre, which constitutes a considerable profit. The wine made from the French vines in Chili is consumed in the country and exported to the Pacific coasts.

Chacoli is a light wine made with the grapes of the country, and which is only slightly fermented in the vat. It is either white or red. This wine is principally drank by the working classes.

The ordinary wine of Chili is a species of liqueur wine, resembling Malaga. It is made by adding to the ordinary "must" one-fourth or one-fifth part of boiled wine.

Mosto is made more or less like Burgundy and Bordeaux wines, and the manufacture is confined chiefly to the South. The province of Concepcion enjoys a high reputation for it.

Mosta asoleado is made from grapes dried in the sun for fifteen or twenty days. The native processes of wine making are of the most primitive kind. The general introduction of good instruments and improved apparatus would render great service to Chili.

Chicha is a very common beverage among the poor. It is made much in the manner of white wine, except that the juice which issues from the wine-press is boiled.

In the province of Aconcagua, a good deal of spirit is distilled from wine. It is, however, of bad quality, owing to the faulty method employed. To cover the bad taste of the alcohol obtained by the direct distillation of the marc, it is the practice to add fennel seed. The spirit thus obtained is known as *anisado.*

LEATHER TRADE.

Particular attention is directed to the present condition of the hide and leather trades in an article in the *Statist*, where the increased competition which the English tanner encounters, is pointed out.

"Taking first hides used in the manufacture of heavy leather, what strikes us is the activity amongst French and German houses for direct shipments. Formerly, England was the great centre for such goods, but now the Continent absorbs by far the largest portion of the trade, especially of South American produce. It is true that a proportion of those hides eventually find their way back to this country, and the strange part is that they are ever allowed to be landed elsewhere, at least to so large an extent. The fact is, after the Franco-German war, a new set of Anglo-German merchants came into existence, with correspondents all over the Continent, and in this way the importi houses are ruled by their foreign coadjutors.

"The rapid increase in the importation of forei leather into this country during the past ten ye supplies material for considerations deeply interesti in a public sense, and of vital importance to the Brit tanner. As our colonies and dependencies gr flourish, and feel their strength, so they pour in u us every product suited to their particular climates overwhelming profusion. Our tanners now behold f similes of their manufactures sent from every quar of the globe, yet cannot themselves export without countering serious, ruinous, hostile tariffs."

From a table of the imports and exports of ele years, from 1870 to 1880 (first ten months), it appe that, in 1870, the imports of leather amounted 11,556,345 lbs., value £759,342, and the exports unwrought leather amounted to 103,788 cwts., va £850,495; of wrought boots and shoes, to 372,601 do pairs, value £1,148,423; while, in 1879, the imports h risen to 35,175,036 lbs., value £2,204,386, the exports the same year only stood at 219,829 lbs.; of unwroug leather, value £1,505,312; and 432,312 dozen pairs boots and shoes, value £1,319,598. Thus the impo of leather more than doubled between 1870 and 18 quadrupled in 1875, and almost quintupled in 18 and seem likely to stand at the end of the present y 400 per cent. higher than at the commencement of t present decade. The exports of leather have material increased, but not in proportion to the imports; whi the foreign trade in boots and shoes, though above 187 nevertheless seems stationary, and would be conside ably less but for the "British possessions in Sou Africa."

SPONGE TRADE IN THE BAHAMAS.

The Report of the Governor of the Bahamas to t Secretary of State for the Colonies has been publish as a Blue-book, with the Report of Professor R Lankester, on the artificial propagation of spong appended. Governor Robinson states that "vario causes combined to make the past year a most favou able one to those engaged in the sponge trade. larger number of buyers than usual appeared in t market, and there was no period when it could be sa that prices had a downward tendency. The very hi prices offered at the beginning of the year were fu sustained to its end. This strong competition served stimulate those actually employed in the fisheries greater exertion, and induced a great many others enter the business. Absence of heavy gales, and t mild weather that generally prevailed, contributed i great measure to favour the efforts of fishermen meet this increased demand. The successful results last year's fishery are also somewhat owing to the r the sponge beds had whilst the privilege of fishi on the coast of Cuba was accorded to the Bahami spongers. Licenses to fish on this coast were aga issued in 1879 to several vessels, but shortly after th arrival at the sponging grounds they were boarded Spanish gun-boats and ordered to leave; some of the returned to port with insufficient sponge to pay t cost of their outfits."

Professor Lankester's report was made in accordan with the request of the Secretary of State for t Colonies, and contains the result of inquiries respe ing the experiments initiated by Professor Os Schmidt, on the artificial cultivation of sponges f commercial purposes.

Mr. Lankester writes:—"The experiments in t Adriatic were carried out under the auspices of t Government during the years 1863-72, and were final abandoned in November, 1872, on account of the dif culties which were encountered. It appears that t method of cutting a sponge into small pieces, affixi

pieces to movable supports, and sinking the s in the water where the sponges naturally was found to be perfectly successful. The s' of sponge attached themselves to the sup- d proceeded to grow each into a well-shaped like that from which the cutting was taken. are given in Dr. Von Marenzeller's report as best mode of taking the cuttings, and as to the terial for supports, also as to the time of year to operate, and other important conditions. It that from a small cutting (26 cubic millimètres in sponge of marketable size would be produced in ven years' growth. Whilst the experiments of rian Government demonstrated the soundness ssor Oscar Schmidt's suggestion, in consequence the cultivation was attempted, yet two diffi- ufficed to put a stop to the undertaking. Firstly, ve population, more especially the fishermen, reat objection to these experiments, fearing that ight lead to the injury of the sponge trade, nsequently they persistently disturbed and the experimental sponge bed. It was necessary sponge cuttings on their supports should be n an open unprotected bay, in order to secure the e condition of the sea water, and natural food of nge, and at the same time the expense of pro- the bay during a long series of years against predations of the fishermen would have been eat, and incommensurate with the profit to be d by the sale of the sponges when full grown. stility of the population of the Adriatic coast n the chief cause of the abandonment of the nents. But, further, the slow growth of the s (first established as a fact by these experiments), e expense of obtaining the cuttings, and of and sinking the supports, seemed to show with rable clearness that the profit to be obtained h a system of cultivation would be extremely

nay be possible, by means of the system of sponge , proposed by Professor Oscar Schmidt, to intro- ponges into new situations previously unoccupied; xperiments in this direction, though requiring kill and knowledge of the conditions favourable ge growth, would be worth trying. Excepting his object, the method of sponge cutting does not o be one of any promise.

relation merely to the management of an exist- onge fishery, I am of opinion that all that can be y official control is to prevent the contamination atural disturbance of the waters and bottom where onges grow; and, secondly, to strictly enforce a ion of size in regard to those sponges which are and sold. Only large sponge should be moved he sea bottom for the market, and all smaller and pletely grown specimens should be returned to aters by the fishermen immediately when taken. er, the ground on which the sponges grow should too often dredged, but only at certain intervals year. In making these recommendations, I am rted by the opinion of Professor Schulze, who has, g the last six years, devoted himself to the study life history of the Adriatic sponges, and has many most important facts to our knowledge of animals."

OBITUARY.

n Joseph Mechi.—This well-known agriculturalist, death occurred on Sunday, 26th inst., was for years a member of the Society of Arts, and served on the Council and on various committees. He orn in London in May, 1802, and was the son of Signor Giacomo Mechi, a native of Bologna. He commenced business early in life at a small shop in Leadenhall-street, and shortly afterwards invented his "magic razor strop." In 1840, he purchased the farm of Tiptree-hall, consisting of one hundred and seventy acres of inferior land, and at once proceeded to apply scientific principles to agricultural practice. He read the first of a series of papers on his farming operations before the Society on November 27th, 1850, and on March 7, 1860, a paper on "The Application of Town Sewage to a large Agricultural Area." He also joined in many discussions at the meetings, and contributed letters to the *Journal*. The last occasion upon which he spoke, was after the reading of Mr. J. C. Morton's paper on "Agricultural Experience," on May 5th of the present year. Mr. Mechi was a juror of the Great Exhibition of 1851, and of the Paris Exhibition of 1855. He was appointed Sheriff of London in 1856, and Alderman of Lime-street Ward, in 1858. On the failure of the Unity Bank, in 1866, of which he was Governor, he resigned his Aldermanic gown, much to the regret of his constituents and of his colleagues. Having determined to pay his share of the liabilities of the bank, which greatly crippled his resources, he felt he should be unable to bear the expenses of the mayoralty. Although Mr. Mechi had attained a good old age, there appears to be no doubt that his death was immediately caused by the misfortunes that overtook him at the end of his useful career. This naturally adds to the regret of the large numbers who now deplore his loss.

GENERAL NOTES.

Ink for Etching on Glass.—An ink which can be employed for writing upon glass, has lately been brought out by Messrs. Sabatier and Co. It consists mainly of hydro-fluoric acid; but there are some other ingredients mixed with it, which enable it to be used as an ink, and which prevent the dangerous fumes which are found so inconvenient in using the simple acid.

Electric Light.—Mr. J. E. H. Gordon, according to *Nature*, has lately patented a method of producing light from electricity, based upon Mr. Spottiswoode's suggestion, to apply the alternating-current magneto-electric machine of De Méritens to the induction-coil. Mr. Gordon arranges small balls of platinum or iridium, or of an alloy of these metals, at the ends of fine platinum rods in pairs in the middle of a suitable globe, and causes to pass between them a rapid succession of sparks, whereby they are raised to incandescence. There is no consumption of carbon or any other substance, and the lamps may be connected either in series or in parallel branched arcs. The principal remaining disadvantage is the noise attendant on the rapid sparks. A mechanical contrivance is added to bring the knobs near together when no current is passing in the primary coil. The induction-coils used are of comparatively small size.

Turin Industrial Museum.—The Royal Italian Industrial Museum was founded at Turin, after the close of the International Exhibition, held in London, in 1862, and the collection for the purpose, made by the Royal Commissioner for Italy, were transferred to a large building, originally a convent, then a provincial college, and the office of the Minister of War, before the seat of Government was transferred to Rome. One of the departments of the museum is the *Archivio Industriale*, in which are preserved and classified the priced lists, illustrated catalogues, and technological pamphlets lately received from all parts of the world. The information contained in these catalogues is freely at the service of all who apply for it, and the authorities are desirous of receiving such lists from all who are willing to send them. The conservator of the museum, Chevalier Jervis, was deputed to collect further objects at the Paris Universal Exhibition in 1878, when he received a large number of objects as gifts from exhibitors in the British Section, and from those connected with the British colonies.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at eight o'clock:—

January 12.—"A Sanitary Protection Association for London." By W. Fleeming Jenkin, F.R.S. On this evening Professor Huxley, LL.D., F.R.S., will preside.

January 19.—"Causes of Success and Failure in Modern Gold Mining." By A. G. Lock.

January 26.—"Five Years' Experience of the Working of the Trade Marks' Registration Act." By Edmund Johnson.

February 2.—"Trade Prospects." By Stephen Bourne.

February 9.—"The Present Condition of the Art of Wood-carving in England." By J. Hungerford Pollen.

February 16.—"The Participation of Labour in the Profits of Enterprise." By Sedley Taylor, M.A., late Fellow of Trinity College, Cambridge.

February 23.—"Recent Advances in Electric Lighting." By W. H. Preece, Pres. Soc. Tel. Eng.

March 2.—"Flashing Signals for Lighthouses." By Sir William Thomson, LL.D., F.R.S.

March 9.—"Improvements in the Treatment of Esparto for the Manufacture of Paper." By William Arnot, F.C.S.

March 16.—"The Manufacture of Aërated Waters." By T. P. Bruce Warren.

Dates not yet fixed:—

"Buying and Selling; its Nature and its Tools." By Prof. Bonamy Price. On this evening Lord Alfred S. Churchill will preside.

"The Discrimination and Artistic Use of Precious Stones." By Prof. A. H. Church, F.C.S.

"The Compound Air Engine." By Col. F. Beaumont, R.E.

"The Increasing Danger to Life and Property from Explosions." By Cornelius Walford.

Foreign and Colonial Section.

Tuesday evenings, at eight o'clock:—

February 1.—"The Industrial Products of South Africa." By the Right Honourable Sir Henry Bartle Frere, Bart., G.C.B., G.C.S.I., D.C.L., LL.D., F.R.G.S., &c.

February 22.—"The Languages of South Africa." By Robert N. Cust.

March 15.—"The Loo Choo Islands." By Consul John A. Gubbins.

April 5.—"Trade Relations between Great Britain and her Dependencies." By William Westgarth.

Applied Chemistry and Physics Section.

Thursday evenings, at eight o'clock:—

January 27.—"A New Mechanical Furnace, and a Continuous System of Manufacturing Sulphate of Soda." By James Mactear.

February 24.—"Deep Sea Investigation, and the Apparatus used in it." By J. G. Buchanan, F.R.S.E., F.C.S.

March 24.—"The Future Development of Electrical Appliances." By Prof. John Perry.

Indian Section.

Friday evenings, at eight o'clock:—

January 21.—"Forest Conservancy in India." By Sir Richard Temple, Bart., G.C.S.I.

February 11.—"The Gold Fields of India." By *Hyde Clarke.*

March 4.—"The Results of British Rule in India." By J. M. Maclean.

March 25.—"The Tenure and Cultivation of Land in India." By Sir George Campbell, K.C.S.I., M.P.

May 13.—"Burmah." By General Sir Arthur Phayre, G.C.M.G., K.C.S.I., C.B.

Cantor Lectures.

Monday evenings, at eight o'clock:—

The Second Course will be on "Watchmaking," by Edward Rigg, M.A. Three Lectures.

February 7, 14, 21.

The Third Course will be on "The Scientific Principles involved in Electric Lighting," by Prof. W. G. Adams, F.R.S. Four Lectures.

March 7, 14, 21, 28.

The Fourth Course will be on "The Art of Lace-making," by Alan S. Cole. Three Lectures.

April 25; May 2, 9.

The Fifth Course will be on "Colour Blindness and its Influence upon Various Industries," by R. Brudenell Carter, F.R.C.S. Three Lectures.

May 16, 23, 30.

MEETINGS FOR THE ENSUING WEEK.

Monday, Jan. 3rd...British Architects, 9, Conduit-street, W., 8 p.m.
Institute of Actuaries, The Quadrangle, King's College, W.C., 7 p.m. Mr. F. N. Newcome, "The Simultaneous Construction of Compound Interest and Annuity Tables."
Victoria Institute, 7, Adelphi-terrace, W.C., 8 p.m. Dr. Andrew Wilson, "The Past and the Present of the Cuttle Fishes."
London Institution, Finsbury-circus, E.C., 5 p.m.

Tuesday, Jan. 4th...Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lecture.) Prof. Dewar, "Atoms." (Lecture IV.)
Pathological, 53, Berners-street, Oxford-street, W., 8½ p.m. Annual Meeting.
Biblical Archæology, 9, Conduit-street, W., 8½ p.m. Annual Meeting.
Zoological, 11, Hanover-square, W., 8½ p.m. 1. Dr. Albert Günther, "Account of the Zoological Collection made during the Survey of H.M.S. *Alert* in the Straits of Magellan, and on the Coast of Patagonia." 2. Prof. Flower, "The Sea Elephant."

Wednesday, Jan. 5th...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 7 p.m. (Juvenile Lecture.) Mr. G. J. Romanes, "Animal Intelligence." (Lecture II.)
Geological, Burlington-house, W., 8 p.m. 1. Mr. C. Callaway, "The Archæan Geology of Anglesey," with a Note on "The Microscopic Structure of some Anglesey Rocks," by Prof. T. G. Bonney. 2. Mr. C. Callaway, "The Limestone of Durness and Assynt." 3. Prof. T. G. Bonney, "A Boulder of Hornblende-Pikrite, near Pen-y-Carnisiog, Anglesey."
Archæological Association, 32, Sackville-street, W., 8 p.m. Dr. Wake Smart, "Notes on Roman Remains, from Nursling, Hants." 2. Mr. G. R. Wright, "The Hardships of the Present Law of Treasure Trove."

Thursday, Jan. 6th...Royal, Burlington-house, W., 4½ p.m.
London Institution, Finsbury-circus, E.C., 7 p.m. Prof. Henry Morley, "Our Living Dramatists."
South London Photographic (at the House of the Society of Arts), 8 p.m. Popular Lantern Display.
Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lecture.) Prof. Dewar, "Atoms." (Lecture V.)
Civil and Mechanical Engineers, 7, Westminster-chambers, S.W., 7 p.m. Mr. R. Harkness Twigg, "Accounts of Sombrero Islands, West Indies, with a Discription of Sub-marine Quarrying of Phosphate of Lime."

Friday, Jan. 7th...Teachers' Association (at the House of the Society of Arts), 10½ a.m. Conference on Sir John Lubbock's Bill for the "Training and Registration of Teachers."
Geologists' Association, University College, W.C., 8 p.m.
Archæological Institute, 16, New Burlington-street, W., 4 p.m.

Saturday, Jan. 8th...Royal Botanic, Inner-circle, Regent's-park, N.W., 3¾ p.m.
Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lecture.) Prof. Dewar, "Atoms." (Lecture VI.)

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FRIDAY, JANUARY 7, 1881.

nications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

CEEDINGS OF THE SOCIETY.

JUVENILE LECTURES.

Vednesday evening, the 5th inst, Mr. G. J. ES, F.R.S., delivered the second of his s on "Animal Intelligence." In continua- the subject of his first lecture, he referred habits of bees and of trap-door spiders, and ssed on to consider instances of the intelli- of the higher animals. He related anecdotes reptiles (including tortoises, turtles, frogs, igators), birds (more particularly noting the of parrots), and mammals, beginning with its, whose sagacity the lecturer thought had mewhat overrated, passing on to cats and rolves and foxes, and ending with monkeys, habits he was now studying at his own home. R. J. MANN, F.R.C.S. (the Chairman), in ng a vote of thanks to the lecturer, related ance of the intelligent speech of a parrot at ic meeting, and added that the human audi- ere not likely to prove less intelligent than rrot, so he was sure that all the boys and resent would join in heartily thanking Mr. es for the two pleasant evenings they had ogether.

CANTOR LECTURES.

: POINTS OF CONTACT BETWEEN : SCIENTIFIC AND ARTISTIC ASPECTS POTTERY AND PORCELAIN.

y Prof. A. H. Church, M.A. Oxon., F.C.S.

RE III.—DELIVERED DECEMBER 6TH, 1880.

Stoneware and other Wares Glazed with Salt.

ra-cotta sometimes tends to pass into stone- A higher temperature of the kiln, and a proportion of vitrifiable material in the body, cessary conditions. And, if iron and sub- s tending to produce opacity and colour be led, stoneware may further advance into paste porcelain. But such transitions are associated with many intermediate conditions, and it is impossible to define strictly what is earthen- ware, what stoneware, and what porcelain. In the two latter materials there must, however, be a binding vitrified cement produced out of the con- stituents of the body at the high temperature of firing. But the nature of the ware produced will depend upon so many factors, that to predict the result of burning any material or mixture is im- practicable. The clays which form the basis of all ceramic materials differ immensely one from the other, and in many directions. The silicates of alumina, of which they mainly consist, are not always identical, much opal is present in some, while imperfect kaolinisation and, consequently, a high per-centage of alkalies, characterise others; the proportion of iron forms another point of difference. The following analysis of different typical clays serve to illustrate the range of com- position, but they by no means exhaust it:—

Percentage of	Stourbridge.	Watcombe.	Teignmouth.	Poole.	Cornwall.
Silica	66	58	53	50	46
Alumina	23	21	30	33	41
Alkalies, lime, magnesia	½	7	3	4	4
Oxide of iron	2	8	2½	2½	trace
Water	8½	6	11½	10½	9

It is particularly important to trace, wherever possible, the dependence on composition of the contraction on firing which clays undergo. It usually varies from 1 to 10 per cent. on the original volume. That silica, in most of its forms, reduces shrinkage has been long known, while the elaborate researches of Mr. George Maw, on the natural clays of the British strata, have given precision to our acquaintance with the effect of heat upon these raw materials of pottery, both in their native state, and when freed from coarse matter by washing.

In attempting to ascertain the relation between the constitutents of stoneware bodies and their outward aspect, one meets with difficulties often insuperable, through the insufficiency of records, especially as to the "Grès Cérames" of foreign origin.

It is, indeed, only within the last few years that chemical analyses, with any claim to accuracy, have been attempted of British ceramic materials and products, and our determinations are still all too incomplete. Naturally, the manu- facturers of to-day, like those of a couple of centuries back, are not ready to divulge the recipes, even if their differences be apparently trivial, which experience has shown to give the most satisfactory results. The manuscript memoranda of Wedgwood. and the published notes of Enoch Wood, Simeon Shaw, and others, have, however, left some record of the materials em- ployed by our Staffordshire white stoneware potters of the eighteenth century. And we have, happily, an extensive series of their ceramic productions still extant for critical study, and for analyses of materials and methods. It is evident that there was a progressive improvement in the materials and

modes of making stoneware in the seventeenth and early part of the eighteenth century. This progress was not exclusively localised in Staffordshire, but was, perhaps, more marked in some other centres of the manufacture. As to the district of the potteries, Shaw states that the body of "crouch ware" was successively made of—

1. Brick-earth and fine sand;
2. Can-marl and fine sand;
3. Grey coal-measures clay, and fine sand;
4. Grey clay and ground flint.

This last and most important improvement is attributed to Astbury, in 1720; the son of this Astbury introduced in 1725 (upon a cream-coloured stone body) a wash of clay and flint. The ground flints were used in lieu of sand, and amounted from 20 per cent. to 25 per cent.

Flint, like sand, increases the hardness and lowers the fusibility of the paste or body, by diminishing the relative proportion of alkalies present. Later on, Josiah Wedgwood further modified and refined the stoneware body. His jasper ware contained more than half its weight of barytes or heavy spar (barium sulphate), while the proportion of clay to ground flint remained the same as before. Translated into per-centages, one of Wedgwood's own early recipes becomes—

	Per cent.
Barytes	57·1
Clay	28·6
Flint	9·5
Barium carbonate	4·8

Other and later recipes for this barytic body are—

Barytes	45	— 45
Kaolin	18	— 10
Blue clay	26	— 15
Flint	11	— 12
Gypsum	0	— 2
Cornish stone	0	— 16

In this jasper ware, the barytes acts in more than one way; for not only does it constitute one of the refractory ingredients of the body, but it forms an infinite number of minute internal reflectors, displaying to advantage any colours which may have been incorporated with the vitreous substance of the ware. Sometimes to baryta must be attributed the chalky and opaque whiteness which is seen in jasper bodies.

The introduction of felspathic constituents into the stoneware mixture alters it in the direction of greater fusibility and translucency. Felspar and china stone are used for this purpose; so high a per-centage of china stone as 40 is not unusual. The great contraction or firing which such stonewares and semi-porcelains undergo, form a considerable drawback to their common employment.

Thus far we have been considering the body or paste of stonewares. Before passing on to the study of the remarkable process of glazing them, a method not adapted for, nor applicable to, other wares, the definition of stoneware, as given by Jacquemart ("Histoire de la Céramique," pp. 7 and 386), may be advantageously cited. He speaks of "*les grès*" as having a dense, very hard, sonorous paste, made from plastic clay, "*degraissé*" by means of sand, silica, or pounded ware. He adds that they are usually glazed by means of salt, sometimes by felspar, forge scales, or pumice; sometimes by a mixture of silica, felspar, b and a little lead. The single baking whic wares require lasts from four to eight days.

I will now turn to the glaze which cons so marked a characteristic of the majority of wares. It is peculiar, not only in its compo but in its mode of application, its manner of f tion, and its appearance. Into its comp scarcely anything enters but soda and silica applied by means of vapour when the body glazed is at a high temperature; it is f partly out of the silica of the ware and part of the vapour with which it comes in conta presents an appearance which differs from glazes, not so much in gloss as in texture, or in distribution on the surface where it ha produced. This texture reminds one of fine l or orange-skin, but it varies in "grain" very wide limits. The most characteristic mens are not generally the most beautifu there is a tendency to excess or deficiency, inequality of glaze, when produced by the sa cess, which causes great variations in the s of a single specimen. The perfection o glaze is sometimes reached on objects of co materials and ordinary workmanship, ev drain - pipes, filters, and chemical app In the white Staffordshire stoneware of tl century, it is frequently seen to combine efficiency as a protective coating with that ex half-gloss which, without interference from i excessive brilliancy on the one hand, or irregularity on the other, brings out both th and the decoration of the body. The exact of the most perfect condition of this salt baffles verbal description, but this, at least, affirmed of it, that its individual particles sufficiently obvious to prevent a completely appearance being produced, must not be enough from each other to be numerable.

The chemical reactions concerned in the of salt-glazing may next claim our attenti will be convenient to speak first of the esse primary part of the change. This may be into two stages:—

$$(a)\ NaCl + H_2O = HCl + NaHO;$$
$$(b)\ 2NaHO + nSiO_2 = NaO_2 n\ SiO_2 + H_{\cdot}$$

In *a* we have the vapour of common salt into the furnace during the last stage of meeting with water-vapour arising from th bustion of the hydrogen of the fuel, and pre a normal constituent of the common air to the of 1 to 1½ per cent. by volume. The two v react, producing hydrochloric acid and soda, the former of which escapes almos pletely, while the latter acts upon certain si constituents of the hot ware, and thus f sodium silicate and water. Questions aris the nature of the silicate thus formed, an the source in the body of the silica which tains. Some experiments lead to the f $Na_2Si_7O_{15}$ for the glaze, and seem to indicate is not all the aluminous silicates of the cl some of them, and part of the free silica, ar alkaline silicates present, with which the s the vapours combines.

A subordinate or secondary reaction occ tween the hydrochloric acid, produced in r *a* above, and any ferric oxide present in th

body: we may formulate this in the following expression—

$$(c)\ 6HCl + Fe_2O_3 = Fe_2Cl_6 + 3H_2O:$$

or we may assume that the common salt vapours act directly upon the ferric oxide thus—

$$(d)\ 6NaCl + Fe_2O_3 + 3H_2O = Fe_2Cl_6 + 6NaHO.$$

If reaction *d* occur, there will be more soda to form additional glaze upon the ferruginous surface, while in both reactions, *c* and *d*, the ferric chloride, which is volatile, will yield, with water vapour, hydrochloric acid and ferric oxide, the latter then combining with the sodium silicate of the glaze to form a double silicate of iron and sodium. Thus, in the salt-glazing process, the iron of the body is brought in some measure to the surface, and contributes additional material to the glaze, while it imparts to it a brown hue. Impure clays, and those which are rich in lime, silica and alkalies, become much more highly glazed than a pure kaolin or china clay. Colouring materials with which the ware may be decorated act similarly. Even a wash of china clay upon a common clay will prevent the extra gloss, commonly formed on the latter, from being produced. Where red lead is mingled with the salt thrown into the kiln, first it is reduced by heat to protoxide, then lead chloride is probably formed, according to equation *e*, decomposed into lead oxide, according to *f*, and fixed on the ware as lead silicate, according to *g*:—

$$(e)\ 2NaCl + PbO = PbCl_2 + Na_2O.$$
$$(f)\ PbCl_2 + H_2O = PbO + 2HCl.$$
$$(g)\ PbO + 4SiO_2 = PbSi_4O_9.$$

Before I take up the study of the individual specimens before us, it may be well for me to say a few words as to the early history of glazing with salt in this country. The subject is obscure. A manuscript by Josiah Wedgwood, dated 15th January, 1765, gives particulars furnished by one Steel, a potter, then aged 84, who remembered the brothers Elers, the Dutchmen, at work at Bradwell. Steel was one of those who went out to see what was the matter when the dense fumes rose from their salt-glaze kiln on the addition of the common salt, and he stated that glazing with salt was first employed by the Elers. Wedgwood agreed with this view, and further assigned to them the introduction of lathe and engine turning and of alabaster moulds. The old story about the origin of salt-glazing, about 1680, through the boiling-over of some brine in an earthen pot, lacks confirmation. It is extremely probable that the brothers Elers did first practise salt-glazing in Staffordshire somewhere between 1688 and 1693, but we are bound to admit the possibility of the process having been used elsewhere in England at an earlier date. As early as 1671, two English patents were granted for making stoneware. One of these, dated 23rd April, 1671, was in favour of J. Ariens van Hammo; the other, dated 13th April, in the same year, was that of J. Dwight, of Oxford. It was for the "mistery of porcelaine or china," and of "stoneware, commonly called Cologne ware." Fortunately, we possess a considerable number of authentic—we may almost say, dated—specimens of Dwight's stoneware. Some of these are earlier than any pieces of Elers' manufacture, and yet exhibit all the characteristics of salt-glaze. The examples in the British and South Kensington Museums, all derived from the collection of Mr. C. W. Reynolds, may be cited as particular illustrations of my statement. But my own examination of a bust of Mrs. Pepys, and of a fine statue of Saturn (both, alas, now lost in the fatal fire of June, 1873, at the Alexandra Palace, when so many ceramic treasures perished), led me to the same result. The specimens discovered on the site of the Fulham works, by their present proprietor, Mr. C. J. Bailey, afford further confirmation of my view.

Thus far I have been directing your attention in succession to stoneware bodies; to the glaze with which they are commonly covered; and to the introduction of that peculiar method of glazing into this country. A few words as to certain salt-glazed stoneware vessels, to which an English origin is assigned by some authorities, may be fitly added now. These wares may be classified thus:—

Class 1.—Brown mottled jugs, often mounted in silver, bearing English plate marks of the Elizabethan period, 1558 to 1603. As "wasters" of these have been found in London, and as they seem to occur almost wholly in England, they, or some of them, were probably made in this country. If so, salt-glazing must be put back more than one century.

Class 2.—The narrow-necked jugs of brown-glazed ware, with a grotesque bearded head in front, known as "Bellarmines." These were certainly made by Dwight, of Fulham, but there seems no direct evidence to prove that any of them were made in England before the year 1671. Yet, if an English origin be accepted for some of the vessels belonging to class 1, there will be no difficulty in reaching a similar conclusion concerning examples of the present class.

Class 3.—Wide-mouthed jugs and cylindrical mugs, bearing applied medallions, with W. R., A. R., G. R., in front, and decorated with incised and applied ornaments, sometimes with cobalt blue and manganese purple upon the designs. These vessels are of drab or pale-brown or grey stoneware, and are salt-glazed. Those of early date, which are most elaborate and well finished in design and colour, can hardly be regarded as English, for the evidence of authentic examples, found at Fulham, does not point to any very high level of artistic excellence having been attained even there, towards the close of the seventeenth century, in this particular class of wares. But notwithstanding this limitation, I am convinced that some good pieces belonging to this third class were really of home manufacture. These are generally without colour, and of somewhat simple if not rude style.

Class 4.—This class consists of white stoneware jugs, usually of half-pint capacity, having a rough medallion in relief of W. R., A. R., or G. R. in front, and often further decorated with simple and rough leafage in dull blue. The glaze is smooth and not produced with salt. The body is not so hard as that of the preceding classes. These vessels are English, but the places of their manufacture can only be conjectured from documents and from "finds" of wasters. Three or four places within the London district have been suggested as the sites of the pot-works where these jugs were made,

but the question is one on which I must not further dwell just now.

Leaving these matters, about which a considerable degree of doubt still hangs, I will now pass on to the study of the most beautiful of the finer original wares ever made in this kingdom, a ware which is peculiar to England and to Staffordshire, and upon which, for about 80 years, an extraordinary amount of skill was exercised. It is remarkable, however, that the Staffordshire potteries no longer remain the seat of the salt-glazed stoneware manufacture. But in the period of 1688 (or 1693) to 1780, an immense quantity of "useful" ware of this kind was made in Burslem and "the Potteries." The question is naturally asked, "Did the Brothers Elers introduce and make it?" That they made this ware we have an argument in the identity of much of the ornament on "red china" of Elers' type with that on early white salt-glazed ware. We have the argument derived from the Continental "tincture," or feeling, which is observable in the impressed and applied ornaments of the ware. We have a consensus of local tradition almost without exception. The authority of Wedgwood, and of other potters of the middle and latter part of the eighteenth century, tends in the same direction. Enoch Wood's ceramic museum contained a large collection of this Staffordshire stoneware, described in Ward's "Stoke-upon-Trent" (1843) as including examples of "the Dutchmen's superior skill." One of the specimens was a pint jug, bearing a medallion of King William III., in relief, accompanied by flowered ornaments stamped in metal moulds; the body was of ash-coloured marl. This jug is spoken of as the earliest specimen of salt-glaze in the Wood collection. It is a great pity that this museum was dispersed; some of the specimens are fortunately preserved in Jermyn-street, and at South Kensington; some are in Edinburgh and Dublin, but the best were given by Enoch Wood to Dresden, while others form part of a private collection in the Potteries. Enoch Wood, however, according to the catalogue of his collection, deemed the white and grey stoneware pieces to have been imported from Germany or Holland. But there is irrefragable evidence to the contrary. As to vessels of 1700 and later, there is no dispute. Enoch Wood possessed a number made of Staffordshire clay, marbled with manganese, glazed with salt, and bearing medallions of Queen Anne; he speaks of these as "chased." Then were introduced slips of Devon or Dorset clay to line or wash or ornament the wares; afterwards the admixture of native clays with flint, then metal moulds, and lastly those of plaster of Paris. We are enabled from these particulars, and from the data which I furnished at the opening of this discourse, to construct a kind of rough chronological division of Staffordshire work in salt-glazed stoneware:—

Period I.—Prior to 1720—Impressed and applied ornaments; ash-grey and dull bodies.

Period II.—1720 to 1740—Flint introduced into the body; fine sharp work.

Period III.—1740 to 1760—Extensive use of coloured enamels in decorating the salt-glazed surface.

Period IV.—1760 to 1780—Prevalent ornamentation of basket and perforated work.

The decoration of the ware comprised a great variety of processes, which may be summaris[ed in] the following scheme:—

Form.
- Engine turning.
- Incised work.
- Applied ornaments cast in moulds.
- Pressed or moulded work.
- Slip-cast in absorbent moulds.

Colour.
- Ash-body with white-wash cut a[way] partially, or with applied ornamen[ts].
- Zaffre or manganese powdering pre[vious] to glazing.
- Enamelling over glaze.
- Transfer printing over glaze in ir[on] or gold violet.
- Oil gilding and japaning.

It should be noticed that the whiteness of th[e] specimens of old Staffordshire stoneware is [due in] some measure to the wood fuel employed for [fir]ing them, and to the protection of saggars. [Mr.] Doulton has kindly refired this old plate f[or me] without a saggar, and in one of his ordinary s[tone]ware kilns. It stood the test well, not ha[ving] suffered in form by the fiery ordeal to which i[t had] been subjected. But the colour of the surfac[e had] been darkened by irregular brownings of the g[laze]. The trial was a severe one, not only for the rea[sons] previously given, but because when a piec[e of] stoneware has been once glazed with salt [the] fusible matter then present on the surface is l[iable] to destroy the refractory character of the bod[y in] a second firing.

[The lecturer proceeded to point out the ph[ysical] and artistic characters of a large series o[f] Staffordshire specimens on the table.]

The modern revival of English stonewar[e has] been so fully dwelt upon in this hall b[y Mr.] Sparkes, that I need do little more than na[me it]. But it is impossible to pass over quite in silen[ce the] marvellous spirit with which Mr. Henry Do[ulton] and those whom he has associated with hims[elf in] the work, have developed an art manufactur[e of a] very high order of excellence out of a larg[e] works, long devoted to the production of very u[seful] but very humble wares. He has pressed in[to] service every element, tried and untried, [that] could be brought into the manufacture, a[nd the] results are widely known and appreciated.

[The lecturer proceeded to point out the d[ecora]tive and physical characteristics of a select [series] of pieces of Doulton's stonewares, including [those] without glaze, those having a glaze esse[ntially] felspathic, and those glazed with salt. He [dwelt] with especial emphasis upon those specimens [which] showed beautiful effects of colour and textu[re due] to accidental flowing, mingling, &c., of c[olour], and to the contrast between glazed and ung[lazed] or partially glazed surfaces.]

The flattery which shows itself in imitati[on has] followed the stoneware revival of Messrs. D[oulton]. The productions of Mr. C. J. Bailey, of Fu[lham]; Messrs. Stiff and Sons, of the London P[ottery], Lambeth; and of Mr. R. W. Martin, of S[outhall] Pottery, resemble the pieces emanating [from] Messrs. Doulton's works in character and m[anner], but are, perhaps, of a less sustained order of [merit]. But, whatever their source and spring, and [how]ever limited in the range of their artistic ele[ments], the products of all the potteries which I have [named] present many features of value and intere[st].

tute a remarkable tribute to the splendid well-deserved success of the originators of this art-manufacture.

o lecture on stoneware could omit all reference he productions of Continental potteries. But brief limits of the time remaining at my disal forbid more than a hasty glance at a few of more characteristic kinds of German and ench stonewares. The study of the specimens the South Kensington Museum and in the ritish Museum will enable any one interested in e subject to discern the peculiarities and, I may ld, the merits which distinguish the four most rominent kinds:—

Class I.—White canettes, glazed and unglazed, longing to the latter half of the sixteenth ntury, and resembling in body the white ffordshire stoneware of the first period. They finely decorated in relief.

Class II.—Yellow and brown short jugs, erally with acorn and oak leaf patterns in high ef, and referable to the close of the fifteenth beginning of the sixteenth century.

Class III.—Jugs, tankards, &c., of greyish ow body, variously decorated with incised and lied ornaments, and frequently further enriched h cobalt-blue and manganese-puce; often attriable to Cologne and Aachen districts. Similar luctions have been traced to Beauvais, in nce.

ass IV.—Tankards, jars, and other vessels of n stoneware, with dark brown or black glaze, decorated further (in the enamel kiln) with l colours, sometimes gilt also. They are of Franconian origin; Jacquemart gives as lity of this manufacture, Creussen, in . Sometimes the wares of this class have nty" look, but the simpler decoration hey occasionally bear, of a white stanniamel on a purplish black ground, is g.

lecturer concluded by describing the chief ristics of the foreign stone wares which rought to illustrate his discourse, pointing causes of the commendable features of foreign specimens, and how the modern reproductions fail to satisfy the feeling r and texture.]

MISCELLANEOUS.

RIPT TO MR. A. J. ELLIS'S PAPER ON HISTORY OF MUSICAL PITCH," AND PPENDIX.

per on "The History of Musical Pitch" is the *Journal of the Society of Arts*, for 5 March, 293—336, and the Appendix, containing a of the principal errors of the press in the aper, and several additions, is printed in the r 2 April, 1880, pp. 400—403. In reprinting private circulation, I was able to make a few s, and, at the last moment, an important adspecting the pitch of Koenig's Ut$_3$, App., . 2, which I am desirous of printing with etail in the *Journal*. I have also been able to e experiments on the influence of temperature h of harmonium reeds, which, as I stated (Hist. of M. P., p. 301, col. 2, end of art. 19), was unknown when my paper was read, and is important for the use of Appunn's tonometer. I have also received some corrections respecting the Temple organ, and an important addition respecting the Strasburg Minster organ. These and one or two other points will be given in this postscript, which has been delayed by the press of other work.

CORRECTIONS AND ADDITIONS.

(1.) *Handel's Fork.*—Page 293, col. 2, note, the Rev. G. T. Driffield, owner of Handel's fork, has removed from the rectory of Bow to that of Old, near Northampton.

(2.) *Influence of Temperature on the Pitch of Harmonium Reeds.*—Page 301, col. 1, last paragraph of art. 19, l. 4, I stated that one of the drawbacks to Appunn's reed tonometers was, that "their variation with temperature was unknown." I have now been able to make at least a close approximation to its determination. In finding the pitch of every reed in Appunn's instrument, as described on p. 301, col. 1, in November, 1879, I worked at a variety of artificial temperatures, from 53° F. to 60° F., all carefully recorded for each reed, together with the numbers of the Scheibler forks with which the beats were taken, and also the precise numbers of beats observed. It occurred to me that by measuring about a dozen of the same reeds of very different pitch, at a much higher temperature, by means of the same forks as before, I should have sufficient data for calculating the amount of alteration for a reed of a given pitch, when subjected to a known variation of temperature. I accordingly took the pitch of a selected number of reeds on one day in July, and two days in September, 1880, at constant natural temperatures of 71½, 73, and 79 deg. F. respectively. I had in each case to allow for the alteration of the pitch of the forks by temperature, and then to determine the pitch of the reed at the higher temperature, and finally to divide the result by the pitch of the same reed at a lower temperature, and by the number of degrees of difference of temperature. As at least ten observations were taken with each fork, and at least two, sometimes three, forks were used for each reed, and the means of each were taken for safety, the calculations were rather lengthy. The resulting figures will appear in a paper in the Proceedings of the Royal Society, where also has appeared my paper on Musical Beats (vol. xxx., pp. 520—533) in which I have given some of the details of my examination of Appunn's tonometer. The mean result is that both tuning forks and harmonium reeds flatten by heat, and sharpen by cold; but while forks alter by about 1 vib. in 20,000, the reeds alter by about 1 vib. in 10,000 (that is, twice as much) for each degree Fahrenheit. This correction should therefore be also made in taking pitches by Appunn's tonometer. Practically if a fork, an harmonium, and an organ were in exact unison, as A 440, at 59° F., then if the temperature were to rise 20° F., as is not unfrequently the case during an evening concert, the fork would flatten to A 439·56, and the reed to A 439·12, whereas the organ would sharpen to A 449·15, which would be terribly out of tune with the harmonium, so that no music should be written, as music has been written, for organs and harmoniums to play together.

(3). *French Pitch at Covent-garden Opera in 1880.*—Page 314, col. 1, after line 7, add—At Kuhe's concert on the 12th of June, 1880, Mr. Hipkins observed that the Covent-garden opera band was in exact unison with his piano there used, which piano had been carefully tuned in French pitch. Quite at the close of the Covent-garden opera season of 1880, he observed that the band had sharpened by three or four vibrations. Hence, the intention to use French pitch was fairly carried out, and the effect of French pitch in operas was well exhibited.

(4). *Handel's Pitch.*—Page 319, col. 2, line 20 from bottom, correct the date of Mr. Brownlow's letter to

21 May, 1858, instead of 1848. Mr. Driffield did not own the fork till 1857.

(5.) *Pitch of the Ancient Concerts at Hanover-square Rooms.*—Page 320, col. 1, l. 6 from bottom of first paragraph, it is stated that in 1805 the organ of the Hanover-square Rooms was built by Elliott "in the usual flat pitch of the period (that is about A 422·5.)" The fork to which that organ was originally tuned was subsequently found by Messrs. Hill, the successors of Elliott, and kindly lent to me for measurement. Hence on p. 321, col. 1, alter the entry A 424·9 to (1) A 424·9; and insert as a new entry:—

(2) **MA 424·9**, MC 508·3, 1 D 568·3 measured (Ellis) 1805. Old D-fork of Elliott's, to which he tuned the organ he built for the Hanover-square Rooms, lent by his successors Messrs. Hill, showing that the estimate under (1) A 422·5 near the end (which see for other particulars) was only V 2·5 too flat. If we calculate from 1 D we find 1 EC 506·3, but if we calculate from MA we find 1 EC 505·3.

Insert among concert organs, p. 334, col. 2, "1805, Elliott, Hanover-square Rooms, S 2·39, A 424·9."

(6.) *Organ of St. Mary's, Shrewsbury.*—(2) **MA 433·6**, l. 2, *for* Byfield and Green, *read*, John Harris and John Byfield, 1729, the makers names originally painted on the organ, altered by Blyth, 1826, and by Brewster and Fleetwood, 1833, *and in line* 3, for 1840*c*, read 1847. This information was supplied by Mr. Hiles, 51, Elsham-road, Kensington, W. Make the corresponding change on p. 334, col 2.

(7.) *Fork of Society of Arts (copy.)* Page 328, col. 2, entry (5) **EA 448·0**, *for* C 332·8 read C 532·8.

(8.) *Strasburg Organ.*—See p. 306, col. 2, l. 20, from bottom, and p. 317, col. 1, l. 11 from bottom.—There is here an attempt to estimate the pitch of A. Silbermann's celebrated organ at Strasburg, which I inclined to put at A 395·8. After much correspondence, and a long delay, I have at last succeeded in obtaining the the pitch of this interesting instrument, through the kindness of Mr. Hipkins, in London, and of Miss Sydney Austin, M. Stockhausen, Director of the Conservatoire, Messrs. Hug frères, musicsellers, Wetzel, the organ builder, and the Abbé Schäffer, organist of the Minster, all of Strasburg. Hence, insert as a new entry on p. 371, col. 2, immediately after A 392·2:—

A **393·2**, MC 470·4, JC 471·8, 1 EC 467·6 measured, S 1·04 (Stockhausen and Ellis) 1713-16. Great organ at Strasburg Minster, built by A. Silbermann. A fork was sent to Strasburg by Mr. Hipkins, and the beats it made with the 1 C of the organ were counted by M. Stockhausen at 16·5 deg. Réaumur. This fork was then measured by me, and the direction of the beats being known by other forks, the pitch of the 1 C at this temperature was determined. It was then reduced to the pitch at 59° F. in the usual way. The Abbé Schäffer informed me that the temperament is now equal, this tuning having been introduced about 1830 by M. Weichmann, when the "echo organ" was increased and placed above in the vault of the church. After the Franco-German War, during which the organ was partly destroyed, it was restored and tuned equally by M. Wetzel. But in every case the pitch of A was preserved, as it was in the original church pitch of A. Silbermann. Then, as 1 C was measured, 2 EA was calculated from it as an equal minor Third lower, which therefore, gave the original pitch, A 393·2, whence the original meantone C 470·4, and just C 471·8 were calculated. The result is probably correct to one or, at most, two vibrations. The pitch is S 1·78 flatter than French pitch, which is about halfway between S 1·50 (or the three-quarters of a tone estimated by ear by M. Stockhausen and M. Wetzel) and S 2·0 (or a whole tone, as estimated by Mr. Hopkins), showing that their estimates were both tolerably correct, for musicians seldom estimate closer than to a quarter of a tone. This organ labours under the defect—which, according to Mr. Davison (of Gray and Davison), was not unfrequent in old org having unequal force of wind, entirely out control of the player, and often altering in notes to the extent of a quarter of a tone. Th intention to contruct a bellows with equal press re-tune the organ thoroughly, in strict equal t ment, when funds allow. It will be observed is a B French-foot-organ, as a mean semiton than its MC 470·4, calculated above, gives M which is almost exactly 450·5, or Bédos's C pipe one French foot in length (see p. 31 MA 376·6). It is the most exact specimen French-foot-organ which I have found, and confirms the pitch assigned to Bédos but the of the present determination. This pitch also within a vibration, with Euler's clavichord, A nearly the same date (1739), and with Dr. determination of the pitch of Trinity College after flattening, MA 395·2. The close agreem the pitch of the organs cited under *Church Pit* to which this belongs, puts the actual use of thi in various countries 150 to 200 years ago beyo reasonable doubt.

(9.) *Comparison of Scheibler's, McLeod's and Measures.*—Appendix, p. 401, col. 2, l. 32, o found also," *to the end* of the table, and in following, which results from measurements ma sequently to printing the Appendix, but is give private reprint:—

Making the corresponding corrections, the r Prof. Mayer's measurements are given in the "Mayer, E." below. Afterwards Prof. measured the forks with the points on, and th the points off, each fork remaining unmove vice for both measurements. It was thus di that the effect of the added points was ve indeed, and that the chief difference general from some loss the forks had sustained in their to America and back, as shown below, the being fractions of V (or the numbers of vibrat second).

Forks.	Conserv.	Tuileries.	Feydeau.	Versailles.
Loss	·0015	·165	·0205	·0285
Points ..	·0475	·035	·022	·022
Sums ..	·049	·200	·0425	·0505

Adding these sums to the values found b Mayer, we find his measurement of the forks in dition in which they were when measured b McLeod and myself at 59° F. The results are the column, "Mayer, McL."

Name of Fork.	McLeod.	Ellis.	Mayer, E.
Conservatoire....	439·55	439·54	439·48
Tuileries........	434·33	434·25	434·26
Feydeau	423·02	423·01	422·91
Versailles	395·83	395·79	395·77
Marloye	255·98	255·96	255·98

The second table on p. 300, col. 1, which wa complete, must be supplemented accordingly. 401, col. 2, l. 11 from bottom, *for* two *read* th l. 7 from bottom, *for* his own fork, V 256·31, own forks, V 256·28, 256·31, *and* p. 402, l. *read* 10. The above corrections were made in th reprint.

(10.) *Koenig's New Standard Fork.*—Page 40 after the paragraph ending on l. 4 add the follo

lt of the various measures of Koenig's Ut_3, p. 401, col. 2, near bottom, was to make it y probable that this fork, which was held to 56, really gave V 256·28 at 59° F. = 15° C., as the temperature at which it was supposed to m constructed, although Koenig had never temperature for which his forks were correct. ible on p. 301, col. 2, I had calculated the of V 64·07, or two octaves lower, on this (to which should have been added the 12th or Sol, 768·84, which was accidentally Last July, in measuring a series of forks by Messrs. Valantine and Carr for Lord intended to give V 128, 160, 192, 256, 320, 768, 1024, 1280, 1536, 2048, I had an op- refully remeasuring all Koenig's harmonic ng to the Royal Institution, and I found vibrations agreeing exactly with those in red to. Since no reasonable doubt could le correctness of these determinations, it hat Koenig's fork was not intended for a 59° F, but for one of about 80° F.

. 300, col. 2, l. 11, I stated that I had oenig had "invented a new and exceed- counting instrument," of which, at the ing my paper, I had seen no description. d was enabled to lend me Koenig's paper, ions of the Vibrations of a Normal Tuning- ersuchungen über die Schwingungen einer gabel, from the *Annalen der Physik und* 30, *Neue Folge*, vol. 9, pp. 391—417, edited lemann, Leipzig) in time for me to insert a script, cn 1 May, 1880, in my private owing that these researches had removed all screpancy between him and me, and that now ely different methods of Scheibler, McLeod, nd Koenig (to which we may add Appunn perly corrected) all led to the same result; so re at last able to determine pitch with great and all the determinations made by myself in story of Musical Pitch" may be trusted as Dr. Koenig has subsequently kindly pre- with a copy of this paper, and a photograph r instrument. His process and results are as

-

he constructed a very large tuning-fork, giving ly 64 double vibrations in a second. The tang of this fork was firmly fixed permanently in a ing part of a solid stand, kept truly horizontal djusting screws, and supporting a frame con- clock, which was wound in the usual way, but ated by the vibrations of the fork, instead of f a pendulum. Its second hand, therefore, was gister 128 single vibrations in a second. By f this clock was another, a chronometer, an time accurately, so that it was easy to see he tuning-fork clock had lost or gained in a ber of hours. As each hour of the tuning- corresponded to 60.60.64 = 230,400 double and 60.60.128 = 460,800 single vibrations, comparatively easy to calculate, by a careful of the two clocks, the exact number of single vibrations made by the fork in one t is, its pitch, to a degree of accuracy hitherto Each prong was furnished with micrometer rying heavy knobs, and, by screwing these n, the pitch could be varied, and finally ac- justed to V 64. A long thermometer hangs ock between the prongs without touching ng accurately the temperature of the air, sufficient time (determined by careful ob- f the fork itself, which, being a heavy mass k some time to show any effects of a change re. To one of the prongs was attached ass of a microscope, of which the body and re attached to the frame, thus forming a bration microscope. The weight of this object-glass was balanced by a steel mirror on the other prong, added for the purpose of producing the Lissajous changing figures, by means of which forks can be accurately tuned to one or two Octaves, or to a Third or Fourth, or even Sixth, above the normal fork. On account of the slowness with which the fork followed the temperature, so that, when depressed by V 2, by heating, it took from two to two and a-half hours to thoroughly recover its former rapidity, it became necessary to operate as much as possible in a constant temperature. But there were great difficulties in keeping up an artificial temperature day and night. Large underground vaults were too cold, being only 12 C.= 53·6° F. in Paris, where the experiments were conducted. Dr. Koenig therefore selected 20° C.=68° F. as his normal temperature, and conducted his experiments in a very large, lofty, and completely closed room, in which temperature altered but slightly, so that the thermometer from morning till night showed scarcely any changes, especially in sunless days, of which he had abundance in Paris in 1879, and he obtained six days in June, and one in September, in which he was able to tune the fork to V 64, at 20° C., during four to eight hours. By these means he obtained, for the first time, an absolute standard for future deductions.

Then he tuned, by the Lissajous figures, another fork to V 256 at 20° C. = 68° F., and by the same process ascertained that its vibrations were absolutely isochronous, which is not always the case when the fork is attached to a resonance-box. Although, in my own experiments, I was not able to find any sensible amount of change which might not be fairly attributed to rrors of observation, Dr. Koenig, by the application of the vibration-microscope, was able to detect very small differences, amounting to V ·0167 in some cases, an amount absolutely inappreciable by ordinary methods of observation.

Dr. Koenig made a series of most important observations on the influence of temperature upon the pitch of tuning-forks, and his conclusion was that "we may say, quite in general, that the number of vibrations made in a second by a tuning-fork varies by one in 8,943 vibrations for one degree Centigrade" = one in 16,097 for 1° F. But different forks are affected differently, and, as his standard V 256 at 20° C. = 68° F. varied by V ·0286 for 1° C, or V ·016 for 1° F., it altered by one in 16,000. The different determinations of the variation of tuning-forks by temperature hitherto made are as follows:—

One in 17,650 or 16,970 by Cavaillé-Coll	for 1° F.
,, ,, 20,000 or 16,670 by Scheibler	,,
,, ,, 20,250 or 18,000 by Kayser	,,
,, ,, 18,280 from 59° to 175° F. by A. J. Ellis	,,
,, ,, 20,490 by Prof. McLeod	,,
,, ,, 22,000 by Prof. Mayer	,,
,, ,, 21,000, as the mean of the two last,	,,
,, ,, 16,097 or 16,112 or 16,000 by Dr. Koenig	,,

The differences for the same observer, arise from the use of different forks, and Dr. Koenig's are founded on the longest series of careful observations; so that, for his forks, his numbers—or, say, one in 16,000 for each degree Fahrenheit—should certainly be adopted.

Dr. Koenig then took his old standard fork Ut_3, intended to give V 256, and comparing it with his new standard at 20° C. he found that at that temperature it gave V 256·1774. Reducing this to 15° C. = 59° F. we have to divide by 16,000 and multiply by 5, giving V ·144 which has to be added, so that according to Dr. Koenig's own reckoning, his Ut_3=V 256·3215. But using the co-efficient of one in 21,000 for 1° F. by which I had calculated (p. 297, col. 1, line 23 from bottom), we should have to divide by 21,000 and multiply by 9, giving V ·1098 to be added, and giving the result V 256·2872. Either result, 256·32, 256·29, differs imperceptibly from the 256·28 at which I had arrived by the measurements of 10 different copies (app. p. 402, col. 1, line 2). Hence all discrepancy between

him and myself ceases. As 256 ÷ 800 = ·32, and 256 ÷ 900 = ·28, we can readily reduce Dr. Koenig's old standards to 15° C. = 59° F. by adding the 800th or 900th part. Taking the coefficient as one in 16,000 for 1° F. according to Dr. Koenig's determination, and the value at 59° F. = V 256·32, we should find that the temperature at which the fork would give V 256 would be 79° F., which agrees with Koenig's 26·2° C. = 79·16° F. Taking, however, my value V 256·28, and my coefficient of one in 21,000 for 1° F., we should find the temperature 80·8° F. In this particular case no doubt Dr. Koenig's determination of the coefficient as one in 16,000 for 1° F. should be assumed. The differences are extremely small, and depend entirely upon the uncertainties involved in the determination of the influence of temperature on forks. To avoid the trouble of calculating the correction for temperature, Dr. Koenig has affixed an apparatus to the end of his standard fork which may be adjusted to temperature, and will then secure V 256 at all temperatures.

Dr. Koenig proceeded to find the real pitch of the French diapason normal in the Conservatoire (see p. 323, col. 2, under A 435·4). He first constructed, by beats at 20° C = 68° F., a fork V 5 sharper than his new standard, V 256, giving V 261 at 20° C.; then, by Lissajous' figures, he constructed a fork forming the exact interval of a major sixth, or 3 : 5 with it. This was V 435, at 20° C., but the intentional pitch of the diapason normal was V 435 at 15° C., and the fork just constructed would give V 435·243 at 15°, according to Dr. Koenig's calculations, where he assumes the coefficient as one in 8,951 for 1° C., or one in 16,112 for 1° F. Hence he constructed by beats a third fork, V ·243 flatter than the former, and obtained a real V 435 at 15° C. (such a fork Koenig had already constructed, unintentionally, and probably not quite so truly, see p. 323, col. 2 (6), A 435·0). This new fork he took to the Conservatoire, and left it for some days beside the diapason normal, in order that both might acquire the same temperature, and then, taking the beats, he determined the diapason normal as V 435·45, but says he could not feel absolute certainty, as the diapason normal would not give beats for more than 20 secs., owing, he thinks, to the action of the resonance box to which it is attached, so that for perfect accuracy it would be necessary to remove it. But, he adds, "Such extreme accuracy would not be of very great interest, because the experiments by which its pitch at 15° C. was determined, have not been published." The statement of the method used, which I have given, p. 323, col. 2, under A 435·4, was made on the authority of M. Cavaillé-Coll. I had previously endeavoured, without success, to learn the method from M. Lissajous, who was responsible for the pitch, but is now dead. This determination, V 435·45, made with such immense care and trouble, agrees almost precisely with mine, V 435·4; but as no provision had been made in the measurements by Mr. Hipkins and my son, for bringing the measuring fork to the temperature of the diapason normal, the process was in no respect so trustworthy as Dr. Koenig's. The near agreement of the result, however, tends to confirm the accuracy of my determinations of pitch. It is impossible to read Dr. Koenig's paper, which I have just summarised, without feeling the utmost confidence in his results, and admiration for his ingenuity, accuracy, and perseverance.

(11.) *Compass of Voice.*—Page 420, art. (3), l. 7 from end, *for* ½ F 135·2 *read* ½ F 1352·0. Corrected in my private reprint.

(12.) *Lavenham Bell.*—App. p. 402, col. 2, art. (7), l. 10 from end, omit *from* Mr. Hermann Smith *to the end* of the paragraph, and insert (the correction was made in my private reprint, after Mr. Lewis had compared a measured fork I sent him, with the little harmonium from which he had estimated the pitch):—

Mr. Lewis, the organ builder, found the famous old tenor bell at Lavenham (16½ miles W.N.W. of Ipswich), date 1625, meant to be and called D, to be 2 D 2 giving MA 431·3, which would be rather sharpe Harris's A 428·7 at Newcastle-upon-Tyne (p. 322, c and is interesting, as occurring in the earliest d mean pitch, and before English organs had been sm by the Puritans, 1644—6.

(13.) *Temple Church Organ.*—The indicatio Appendix No. 9 (p. 402 of original, and p. 403 print) contain several errors, and should be repla the following, in which the parts in inverted co are arranged from communications from Messrs. F and Andrews, organ builders, Hull, who last r the organ. Insert on p. 327, col 1, after *A 444·3

*(2) A 444·3, B *flat* 471·4, B 498·6, C 529 all mea (Ellis), 1880, London; Temple Church organ, aft organ had been rebuilt in 1877-8, by Messrs. Foste Andrews, who found the pitch "to be a good flat to the Society of Arts fork, which pitch is st tained." The fork mentioned was a copy by Metze was measured by me at C 532·2, which is percep sharper than the existing C 529, agreeing with a "No transposition of pipes was made by Messrs. F A. during the rebuilding. The organ was origi in the eastern arch of the round church, whence i removed in 1840-41 by the Mr. J. C. Bishop, (d. 1 and re-arranged and erected in 1843 in the chamber, where the present instrument stands, the being taken out of a window in the choir, and a organ room constructed. On commencing the mu finishing, the whole of which was done in the ol and on the old sound boards" (consequently reta the old quarter tones, E *flat* and D *sharp*, A *flat* a *sharp*, as originally at Durham, see p. 330, col. line), "the pitch was found to be very shar sharp by more than a quarter of a to that the transposition of one pipe was not su to make it equal to the pitch then in us hence, on account of the quarter-tones, Mr. Bishop determined to transpose *two* pipes upwar insert two new pipes in each stop. This work wa by Mr. Forster, sen." Now here arises a dif Mr. C. A. Bishop (son of Mr. J. C. Bishop) b that his father always used "Smart's pitch," wh 1843, ought to have been A 433, MC 518, see col. 2, but may have been Smart's old pitch, wh the original Philharmonic pitch, see p. 320, col. 423·7, C 506·8. This agrees with Mr. Clarke' ment that the Temple organ was in exact with Handel's fork, see p. 319, col. 2 (1) A 422· but then Mr. Clarke's statements respecting th of the ancient concerts as being a whol above this pitch, have been entirely discredited (lines of same entry). Messrs. F. and A. say th organ was, in 1843, "finished to a fork supposed 512." But, considering that at about this time C was believed to be C 512 (see p. 326, col. 1, A 4 which would be manifestly far too sharp, possibly C or C 507, might also have been supposed to be C It is clear, however, that the organ was lowere more than a quarter of a tone. If we take Mr. C to be right (and he could hardly be much wrong unison, although liable to errors arising from uns temperature), Mr. J. C. Bishop left the orga A 422·5 MC 505·4, having probably found it at A 4 B. Schmidt's Hampton-court pitch (p. 326, col. 1), is S ·77 sharper, that is, just between a quarter and tone, or thereabouts. This supposition seems to rec all the statements best. If we took Smart's a pitch, used in 1843, of A 433, it would beat too str with Handel's A 422·5 (except in very hot we indeed, upwards of 80° F.) for any reasonable suppose they were identical. This second pitch also give as an original, about A 454·2 (see p. col. 1), which was not likely to have been any used by B. Schmidt (see table on p. 331, col. the discussion under A 474·1). "The organ re new sound boards from the late Mr. Robson,

...at is, the quarter-tones were then abolished, ...any new stops by Schulze and Robson. ...ch was then raised by Robson," to its state A 444·3, which, by the above discussion, ...bably very nearly its original pitch, "but ...iciently for the stops made, and finished ...any by Schulze, as may be seen on examining ...s now in use." The pipes, when measured, ... in precise equal temperament, which would 444·3, EB *flat* 470·7, EB 498·7, EC 528·4, or EB 499·3, EB *flat* 471·3, EA 444·8.

...regard to *St. Paul's organ*, which Mr. Clarke ...ted to be in unison with Handel's fork (p. 319, A 422·5), Messrs. Forster and Andrews say that, ...s not altered in pitch by the late J. C. Bishop, ...been made flatter some years previously to 1839, ...as then stated, by Allman and Nutt. Every ...ipe in the organ had been pieced, even to the ...ixture pipes, but at that date there had been no ...sition of pipes." This makes it probable that St. ...the Temple, and Hampton Court, were all ...ly at the same pitch, about A 442, MC 529.

Belgian Army Military Instrument Pitch.—App. p. 403. Omit the passage, l. 15, "Hence, as ...r," . . . to l. 20, "more probable," which ...ated before Dr. Koenig's correction of his own ...as known, and insert:—

...arge copies I measured were A 451·7, at 59° F. ...must have measured by his old standard, so ...lding one in the 800 (see above, No. 10), we ...V 451·56 at 59° F., which agrees so closely with ...surement, that the difference may arise from ...rors in copying by ear, or else Koenig may have ...ed himself with giving the nearest number of ...e single vibrations, and thus called SV 902·25 ..., which would account for the difference.

...e end of this paragraph, App. 10, add, as in my reprint:—

...ictor Mahillon also says that the so-called fork Belgian Guides (see p. 330, col. 1, A 455·5), pro-...peaking, never existed. The pitch of A was ...ally given by M. Bender on a small clarinet, on ...he played, and such a pitch is, of course, very ...in. Mons. C. Mahillon, however, possessed a ...ken from it, which was at lowest A 456.

Schulze's Tynedock Organ. Page 403, App. 11, Omit "For a similar pitch" to the end of the ...ph.

...above are all the additions and corrections that I ...yet found it necessary to make. In conclusion, ...express my thanks to the Society of Arts for ...g me a silver medal for my "History of Pitch."

Alexander J. Ellis.

...-road, Kensington, W., 29 Dec 1880.

OBITUARY.

...house, F.R.S.—John Stenhouse, LL.D., the ...hemist, died on the 31st December, 1880, in ...y-second year of his age. He was a native ...r, in which city he lived for many years. On ...on of the failure of the Western Bank of ...which deprived him of his fortune, he came to ...nd was appointed Lecturer on Chemistry at ...lomew's Hospital. This appointment he was ...resign in 1857, on account of a severe attack ...is, which disabled him. He succeeded Dr. ...as non-resident assayer to the Mint in 1865, ...this office was abolished by the Chancellor ...chequer (Mr. Lowe). Dr. Stenhouse was ...Royal medal by the Council of the Royal Society in 1871," for his researches on the lichens, and their proximate constituents and derivatives, including erythrite, and for his researches on the action of charcoal in purifying the air." In 1854 he read a paper before the Society of Arts, "On the Deodorising and Disinfecting Properties of Charcoal, with the Description of a Charcoal Respirator for Purifying the Air by Filtration," and in 1861 he was elected a member. Besides the charcoal respirator, he was the inventor of a charcoal ventilator for sewers, and a process for rendering fabrics waterproof by means of paraffin. Although his bodily powers were much enfeebled, he continued his scientific researches up to the last.

GENERAL NOTES.

The Electric Light at the Liverpool Docks.—It was resolved at a recent meeting of the Mersey Docks and Harbour Board, that the electric light should be adopted at a portion of the new dock system at the north end of the city, the estimated cost being £2,000. This is to be an experiment, and upon the result will depend the extension of the light over the docks generally.

Society of Telegraph Engineers.—The library of the Society (which includes the Ronalds Library) is now open daily, between the hours of 11 a.m. and 8 p.m., except on Thursdays and Saturdays, when it closes at 2 p.m. The privilege of using the library is extended to members of all scientific bodies, and to the public generally, on application to the Librarian, at the Society's house, 4, Broad Sanctuary, Westminster.

International Woollen Exhibition.—At the request of several foreign States, the time for receiving applications for space at this Exhibition, which will be held this year at the Crystal Palace, has been extended to the 1st April. The Government of New Zealand has asked for 1,500 square feet of space, and articles that have been shown at the Sydney and Melbourne Exhibitions will be sent from New South Wales and Victoria. The applications to exhibit machinery in motion are stated to be so numerous that it is expected that a large portion of the main floor of the building will be assigned for this purpose.

International Exhibition of Hygiene.—At a meeting of the Committee of the Parkes Museum of Hygiene, it was resolved "That her Majesty's Commissioners of 1851, having expressed to the committee of the Parkes Museum of Hygiene their willingness to provide space at South Kensington for an Exhibition of Sanitary Appliances and the Industries Connected with Medicine on the occasion of the Industrial Medical Congress in 1881, it is desirable that the committee should organise such an Exhibition, provided that a sufficient guarantee fund be obtained." Those desirous of assisting the committee are requested to send their names to the treasurer of the Museum, Professor Berkeley Hill.

Moscow Industrial Art Exhibition.—The fifteenth Exhibition of manufactures and artistic productions of the Russian Empire will be held at Moscow from the 15th May to the 15th September, 1881. The articles exhibited will be divided into 83 classes, arranged under 11 groups. Group 1.—*Works of Art* will consist of oil paintings, sculpture, architecture, engravings, art metal work, and water colours. Group 2.—*Scientific Educational Subjects*, including musical instruments, typography, lithography, photography, &c. Group 3.—*Agricultural Productions*. Group 4.—*Mining Productions and Salt Industry*. Group 5.—*Manufactures from Fibrous Substances*. Group 6.—*Manufactures from Metal*. Group 7.—*Productions Manufactured at Works*, as sugar, starch, tobacco, candles, soap, oils, leather, india-rubber, paper, glass, chemicals, &c. Group 8.—*Industrial Manufactures*, bookbinding, upholstery, clothing, &c. Group 9.—*Machines, Apparatus, Materials of Construction, and Workmanship*. Group 10.—*Horticulture and Gardening*. Group 11.—*Domestic Animals*.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock:—

JANUARY 12.—"A Sanitary Protection Association for London." By W. FLEEMING JENKIN, F.R.S. On this evening Professor HUXLEY, LL.D., F.R.S., will preside.

JANUARY 19.—"Causes of Success and Failure in Modern Gold Mining." By A. G. LOCK.

JANUARY 26.—"Five Years' Experience of the Working of the Trade Marks' Registration Act." By EDMUND JOHNSON.

FEBRUARY 2.—"Trade Prospects." By STEPHEN BOURNE.

FEBRUARY 9.—"The Present Condition of the Art of Wood-carving in England." By J. HUNGERFORD POLLEN.

FEBRUARY 16.—"The Participation of Labour in the Profits of Enterprise." By SEDLEY TAYLOR, M.A., late Fellow of Trinity College, Cambridge.

FEBRUARY 23.—"Recent Advances in Electric Lighting." By W. H. PREECE, Pres. Soc. Tel. Eng.

MARCH 2.—"Flashing Signals for Lighthouses." By Sir WILLIAM THOMSON, LL.D., F.R.S.

MARCH 9.—"Improvements in the Treatment of Esparto for the Manufacture of Paper." By WILLIAM ARNOT, F.C.S.

MARCH 16.—"The Manufacture of Aërated Waters." By T. P. BRUCE WARREN.

Dates not yet fixed:—

"Buying and Selling; its Nature and its Tools." By Prof. BONAMY PRICE. On this evening Lord ALFRED S. CHURCHILL will preside.

"The Discrimination and Artistic Use of Precious Stones." By Prof. A. H. CHURCH, F.C.S.

"The Compound Air Engine." By Col. F. BEAUMONT, R.E.

"The Increasing Danger to Life and Property from Explosions." By CORNELIUS WALFORD.

FOREIGN AND COLONIAL SECTION.

Tuesday evenings, at eight o'clock:—

FEBRUARY 1.—"The Industrial Products of South Africa." By the Right Honourable Sir HENRY BARTLE FRERE, Bart., G.C.B., G.C.S.I., D.C.L., LL.D., F.R.G.S., &c.

FEBRUARY 22.—"The Languages of South Africa." By ROBERT N. CUST.

MARCH 15.—"The Loo Choo Islands." By Consul JOHN A. GUBBINS.

APRIL 5.—"Trade Relations between Great Britain and her Dependencies." By WILLIAM WESTGARTH.

APPLIED CHEMISTRY AND PHYSICS SECTION.

Thursday evenings, at eight o'clock:—

JANUARY 27.—"A New Mechanical Furnace, and a Continuous System of Manufacturing Sulphate of Soda." By JAMES MACTEAR. J. C. STEVENSON, M.P., will preside.

FEBRUARY 24.—"Deep Sea Investigation, and the Apparatus used in it." By J. G. BUCHANAN, F.R.S.E., F.C.S.

MARCH 24.—"The Future Development of Electrical Appliances." By Prof. JOHN PERRY.

INDIAN SECTION.

Friday evenings, at eight o'clock:—

JANUARY 21.—"Forest Conservancy in India." By Sir RICHARD TEMPLE, Bart., G.C.S.I.

FEBRUARY 11.—"The Gold Fields of India.' HYDE CLARKE.

MARCH 4.—"The Results of British Rule in I By J. M. MACLEAN.

MARCH 25.—"The Tenure and Cultivation of in India." By Sir GEORGE CAMPBELL, K.C.S.I.

MAY 13.—"Burmah." By General Sir A PHAYRE, G.C.M.G., K.C.S.I., C.B.

CANTOR LECTURES.

Monday evenings, at eight o'clock:—

The Second Course will be on "Watchma by EDWARD RIGG, M.A. Three Lectures.

February 7, 14, 21.

The Third Course will be on "The Sc Principles involved in Electric Lighting," b W. G. ADAMS, F.R.S. Four Lectures.

March 7, 14, 21, 28.

The Fourth Course will be on "The Art o making," by ALAN S. COLE. Three Lectur

April 25; May 2, 9.

The Fifth Course will be on "Colour Bli and its Influence upon Various Industrie R. BRUDENELL CARTER, F.R.C.S. Three Le

May 16, 23, 30.

MEETINGS FOR THE ENSUING WEE

MONDAY, JAN. 10...Institute of Surveyors, 12, Great Geor S.W., 8 p.m. Resumed Discussion on Mr. paper, "The Land Question in 1880."
Medical, 11, Chandos-street, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 5 p.m Harrison, "The French Revolution and th Histories of it."

TUESDAY, JAN. 11...Medical and Chirurgical, 53, Bern Oxford-street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, We S.W., 8 p.m. Inaugural Address by the Pres Abernethy, and Monthly Ballot for Members.
Photographic, 5A, Pall-mall East, S.W., 8 p.m Viles, "The Optical Lantern."
Anthropological Institute, 4, St. Martin's-pla 8 p.m.
Royal Horticultural, South Kensington, S.W., 1

WEDNESDAY, JAN. 12...SOCIETY OF ARTS, Joh Adelphi, W.C., 8 p.m. Prof Fleeming Jen Sanitary Protection Association for London."
Graphic, University College, W.C., 8 p.m.
Microscopical, King's College, W.C., 8 p.m. 1. Martin Duncan, "Three Microspongiadæ to the Hexactinellids from the Deep Sea." Shadbolt, "The Aperture Question." 3. Prof "The True Conditions of Stereoscopic and Ps Effect in Microscopical Vision." 4. Mr. A. D "A Species of Acarus believed to be Unrecord
Royal Literary Fund, 10, John-street, Adelp 3 p.m.
Obstetrical, 53, Berners-street, Oxford-street, V

THURSDAY, JAN. 13...Royal, Burlington-house, W., 4½ p.
Antiquaries, Burlington-house, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 7 p Henry Blockburn, "The Art of Popular Illus
Inventors' Institute, 4, St. Martin's place, W.
Royal Society Club, Willis's-rooms, St. Jame 6 p.m.
Mathematical, 22, Albemarle-street, W., 8 p.m A. J. Ellis, "An Apparently Paradoxical R the Circle, Parabola, and Hyperbola." 2. I Terry, "A Proof of the Differential Equatio satisfied by the Hypergeometric System." R. Westropp Roberts, "The Periodicity o Elliptic Integrals of the First-class." 4. I Roberts, "The Tangents drawn from a I Nodal Cubic."

FRIDAY, JAN. 14...Astronomical, Burlington-house, W.,
Philological, University College, W.C., 8 p.m.
Quekett Microscopical Club, University Colleg p.m.
Clinical, 53, Berners-street, W., 8½ p.m. Annual

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FRIDAY, JANUARY 14, 1881.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

MUSICAL EXAMINATIONS.

The Society of Arts' practical examination in vocal and instrumental music was held, as announced, on Monday and Tuesday, January 10th and 11th, by John Hullah, LL.D., assisted by W. Barrett, Mus. Bac. Seventy-two candidates were examined. Dr. Hullah has promised a report, which will appear shortly.

The next practical examination will be held during the week commencing 11th July, 1881. Information as to these examinations can be obtained from the Secretary.

SIXTH ORDINARY MEETING.

Wednesday, January 12th, 1881; Professor THOMAS H. HUXLEY, LL.D., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Ameuney, Antonius, 87, Seymour-street, Hyde-pk., W.
Ball, John Ball, F.R.G.S., Carisbrooke-lodge, St. John's-road East, Putney.
Carpmael, Edward, Streatham-hill.
Clark, Mateo, 88, Richmond-road, Bayswater, W.
Crowther, Richard William, 18, Cockspur-street, S.W.
De Villiers, Peter, M.D., Ellora-villa, Silverhill, St. Leonards-on-Sea.
Fell, John Barraclough, The Warren, Torrington, Devon.
Folkard, Henry Tennyson, Wigan.
Gostling, William Kennedy, 8, Gloucester-square, Hyde-park, W.
Herring, John Barnwell, The Grove, Esher, Surrey.
Hill, Robert Martin, 117, Leadenhall-street, E.C.
Klein, Adolphe Louis, Burton-in-Lonsdale, Yorkshire.
Robinson, Robert Alleyne, South-lodge, Cockermouth, Cumberland.
Sawyer, William Phillips, Drapers'-hall, Throgmorton-street, E.C.
Smee, Arthur R., Penrhyn-lodge, Woodberry-down, N.
Standfield, John, 6, Westminster-chambers, S.W., and 44, Lilliesshall-road, Clapham, S.W.
Surtees, Colonel Charles F., Chalcott-house, Long Ditton, Surrey.
Tapson, John, M.D., 12, St. German's-place, Blackheath.
Theobald, John Peter, The Chestnut-grove, Kingston-on-Thames.
Thompson, John, Mayor of Peterborough.
Timmis, Illius Augustus, 17, Parliament-street, S.W.
Waterlow, Herbert Jameson, 1, The Avenue, Brondesbury, N.W.
Wiggins, Rev. William, Spring-vale, Tonge, Middleton, Lancashire.
Wilson, Rev. Charles Thomas, Chapmore-end, Ware.
Wood, James, 26, Cross-street, Ryde, Isle of Wight.
Wright, E. G., 330, Commercial-road, Landport.

The following candidates were balloted for, and duly elected members of the Society:—

Aird, David Alfred, 2, Sussex-gardens, Hyde-park, W.
Angus, Joseph, The Hermitage, Langley-lane, South Lambeth, S.W.
Clements, Hugh, 5, Park-terrace, Peckham, S.E.
Foster, Thos. Nelson, Allt Dinas, Bayshill, Cheltenham.
Morton, Joseph, 39, Cheapside, E.C.
Obach, Dr. E., 17, Charlton-villas, Church-lane, Old Charlton, S.E.
Riddiford, George Francis, Barnwood-lodge, Glouceste
Ridpath, J. Lionel, 12, West Kensington-gardens, W.
Snelgrove, Horatio Richard, The Grove, Clapham-common, S.W.
Sykes, Fred. W., Gosport Mills, Huddersfield.
Traill, James Christie (of Rattar, N.B.), Castlehill, Thurso, Caithness.
Vogel, Sir Julius, K.C.M.G., 135, Cromwell-road, South Kensington, S.W.
Ward, Frederick Peterson, 46, Hamilton-terrace, St. John's-wood, N.W.
Wright, John Brooks, 96, Buchanan-street, Glasgow.
Young, Charles E., 71, Clapham-road, S.W.
Young, Sir Charles Lawrence, Bart., 5, Ashburn-place, Cromwell-road, S.W.
Young, George, 7, The Terrace, Ryde, Isle of Wight, and 43, Dover-street, Piccadilly, W.

The paper read was on—

A SANITARY PROTECTION ASSOCIATION FOR LONDON.

By Prof. Fleeming Jenkin, F.R.S.

Many present may, in the first place, be inclined to ask the question, What is a Sanitary Protection Association? A short account of how the first association of this kind came into existence may, perhaps, convey a clearer idea of the objects aimed at than any mere enumeration of those objects, such as might be given in a prospectus. In the winter of 1877-78, the writer was asked to deliver two lectures on Sanitation before the Philosophical Institution in Edinburgh, and he gladly accepted the duty, believing that there would be no great difficulty in giving simple explanations on the subject, and in laying down rules so simple that each householder might easily apply those rules to his own case, and so render himself secure against the chief dangers arising from bad drainage, bad water supply, and bad ventilation. There is, practically, no serious difference among experts as to the principles to be observed, or, perhaps, it might be more correctly said that there exists a practical agreement as to the main principles and chief points of practice, and that the differences as to practice relate only to minor details. Undoubtedly, a warm discussion often arises, even now, as to the relative merits of various forms of sanitary apparatus, but this discussion is often hottest when the several forms are all good; and an impartial hearer might observe that all speeches appealed to common, well-proved principles, by which the several appliances were judged. The writer holds the opinion that, while niceties of construction cannot be too warmly debated among manufacturers and engineers, they are, nevertheless, of small importance in comparison with a few very simple conditions, the observance of which

will practically ensure that a house is in good sanitary order. Very briefly, these main conditions may be stated as follows:—

1. The liquid refuse from the house must have a free passage to the town sewer.

2. The air from the town sewer must not have a free passage into the house drains.

3. No air or gas from the drainage channels of the house must enter the house.

4. No water or liquids must leak from those channels into the ground under the house.

5. The drinking water must be supplied and stored in such a manner as to run no risk of contamination.

6. The air of the dwelling rooms must be supplied from without uncontaminated.

These points could easily be made clear to an audience, but then came the difficulty of explaining how the various pipes and traps throughout the house ought to be arranged, with a view to securing these conditions; then it was further necessary to explain the modes of practically testing whether pipes were open that should be open, passages closed which should be closed; whether the various channels, with their joints, were so made as to be and remain gas-tight and water-tight. By the time these details, with the necessary diagrams and experiments had been arranged for the lecture, the matter no longer appeared thoroughly simple; indeed, the diagram showing the pipes of a very small house, although made purposely simple for the purpose of explanation, presented an appearance so complex that, after the lecture had been given, one of the audience was heard to remark jocularly, that he had not room in his whole house for such a number of pipes as that. The anecdote tells against the lecturer, for it shows that he had utterly failed to explain his meaning to his hearers; but it also serves to illustrate an undoubted fact, that most householders are quite unaware of the great number and complexity of the channels which penetrate their houses, and yet each one of those channels may become a source of danger.

By the time that the preparations for the lecture were complete, the writer had arrived at the discouraging conclusion that its delivery would be practically useless—that it would add little or nothing to the knowledge of experts, and that the ordinary householder could not be expected so completely to master the subject as might warrant him in trusting to his own judgment when applying the principles. What conclusion, then, was to be drawn? Apparently, only the very lame one, that each occupier ought to call in professional advice, to see, in the first instance, that proper arrangements had been made, and from time to time to inspect whether they continued in working order. But what advice could the public obtain? The plumber and builder were interested parties, and in many cases were insufficiently educated to give sound advice. The engineer, if consulted, must be a man of standing, and would charge a fee such as would be prohibitory in the case of houses belonging to persons of moderate means. The public authorities were in Edinburgh, the Medical Officer of Health and Burgh Engineer. These might be consulted in any case where a nuisance was detected, or even suspected; but it formed no part of their duty to give detailed professional reports as to the arrangement and condition of private houses, in which there was no special reason to suppose that serious defects existed. These officials would have had good reason to complain if the writer had induced 500 or 1,000 householders at once to apply for plans and diagrams of their drainage and water supply, accompanied by detailed reports and specifications of changes necessary or desirable, and to be followed by a subsequent periodical and practical inspection of these works. It was, moreover, obvious that the householders would not be induced to make this application. The lecturer, then, was in the position of having to tell his hearers that the water-carriage system, as it is called, had introduced into their houses a very serious danger; that the complexity of pipes and traps was such that this danger could not be guarded against without professional advice and continual inspection, and yet that no practical means existed, by which men of moderate means could obtain trustworthy professional advice. This conclusion was so unsatisfactory, that he was led to consider whether no plan could be devised for giving sound professional advice and inspection in return for small fees. The idea then occurred to him that the principle first applied by the late Sir William Fairbairn to the inspection of steam boilers, was also applicable to the inspection of houses. An association might be formed, which should employ an engineer or engineers of their own. Each engineer so employed, could inspect and report on a large number of houses annually, and if employed exclusively on this work, he would rapidly acquire great skill and experience. The writer knew that large numbers of well educated young men, who passed through his class in the University and through their practical apprenticeship, would be glad to give their time for about £150 per annum. If these men were to inspect houses and report upon them under the eye of a consulting engineer of standing, the householder would have a guarantee that the principles on which the reports were drawn up, and the inspections made, were such as commanded the assent of the heads of the profession, and, nevertheless, the fee of the consulting engineer who gave this guarantee need not be more, for, say, 100 houses, than he would have to charge for a single house if he were called in for that one special case.

An estimate showed that, including the payment of a secretary, rent for offices, and sundry minor expenses, the proposed benefits could be given in Edinburgh for a subscription of £1 1s. per annum, an estimate which has since been justified by an experience of three years.

The idea was explained privately to a few friends, and met with so much favour that draft rules were passed, and the following circular issued:—

SANITARY PROTECTION ASSOCIATION.

Edinburgh, 21st January, 1878.

SIR,—I have the honour to enclose for your consideration the draft of a prospectus of this association, which is in course of being formed. Your special attention is requested to the following points:—

1. The association is a society for the benefit of its members and the community, and cannot, under its articles, be used for any purposes of profit.

2. The privileges of members include the annual in-

spection of their premises, as well as a preliminary report on their condition, accompanied by an estimate of the cost of any alterations recommended.

3. Even when drains and other sanitary appliances have been put in thorough order, it is impossible to secure that they shall remain in that state without the skilled inspection, from time to time, which it is one main object of the association to provide.

4. No obligation will rest on members to carry out the recommendations made by officers of the association, whose one duty will be to give skilled advice when this is desired by the members.

5. The officers of the association will have no interest in recommending any outlay.

6. The association may (under Rule 5) be of great service to the poorer members of the community.

The following gentlemen have approved of the rules of the association, and consented to act as a provisional committee of management until 500 names shall have been enrolled. Upon this the first general meeting will be held, and a permanent council appointed:—

Provisional Committee.—The Right Hon. the Earl of Rosebery; the Right Hon. Lord Moncreiff, of Tulliebole, Lord Justice-Clerk; the Right Hon. the Lord Advocate, M.P.; Sir Robert Christison, Bart., D.C.L.; the Hon. Lord Shand; the Hon. Lord Craighill; the Hon. Lord Rutherfurd Clark, LL.D.; James Cowan, M.P.: the President Royal College of Physicians; the President Royal College of Surgeons; the Right Rev. Bishop Cotterill, D.D., &c.

Should you approve of the object of the association, and wish to become a member, you are requested to sign the enclosed form, and send it to the temporary office, 35, North Frederick-street, addressed to the Interim Secretary, Captain Charles Douglas [of No. 2, Rutland-square]. I have the honour to be,

Your most obedient servant,

FLEEMING JENKIN.

The rules of the association were revised by the provisional committee, consisting of leading citizens in Edinburgh, and the writer was able, at his lecture before the Philosophical Institution, just three years ago, to announce that the association for Edinburgh was constituted. Since that time, and under those rules, the association has worked with perfect smoothness and success. It has given satisfaction to its members; it has paid its way; it has spread widely through Scotland, and its action has in no instance given rise to any challenge or ill-feeling. Under these circumstances, the Council of the Society of Arts accepted the present paper, by which the announcement is made that a similar association is now founded in London.

The rules of the London Association are appended. They differ little from those of the Edinburgh Association, and such differences as exist have been adjusted by the London Council. The following abstract will probably be sufficient to explain what the association undertakes to do. The objects are defined as follows:—

1. To provide members, at moderate cost, with such advice and supervision as shall ensure the proper sanitary condition of their own dwellings.

2. To enable members to procure practical advice, on moderate terms, as to the best means of remedying defects in houses of the poorer class in which they are interested.

The entrance fee, which entitles to all privileges of membership for twelve months, is £2 2s. for houses situated within five miles of Charing-cross and rated below £400 per annum. The subsequent annual subscription for the same houses will be £1 1s. Special rates for larger houses can be ascertained from the Secretary.

The following are the privileges of the members:—

1. A report by the engineer of the association on the sanitary condition of one dwelling, with a sketch diagram of pipes, and specific recommendations, if necessary, as to the improvement of drainage, water supply, and ventilation.

2. The inspection of any alterations in the sanitary fittings which may be carried out by the advice, or with the approval, of the officers of the association.

3. An annual inspection of premises by the engineer, with a report as to their sanitary condition.

4. Occasional supplementary inspection and advice concerning the dwelling or property in respect of which he is a subscriber, whenever this advice may be desired. The fee for such occasional advice will be fixed from time to time by the Council.

5. Reports by the officers of the association as to the sanitary condition of any dwellings or properties designated by any member, or on any plans for proposed buildings, on payment of a fee to be fixed by the Council from time to time, with special relation to the rent, or estimated rent, of the premises.

6. A vote in the election of the council, who manage the affairs of the association.

Any member is free to leave the association at any time; non-payment of the annual subscription will suffice to cause the removal of his name from the roll. The association has no share capital and no profits. The Board of Trade have signified their willingness to license the Edinburgh Association as one of public utility under the Act of 1867, Victoria 30—31, c. 131, and the Board will, no doubt, be prepared to grant an equal privilege to the London Association.

The Council of the association will, by its articles, be unpaid; the officers have no interest in any outlay or patent.

The first council will be constituted as follows:—President—Prof. T. H. Huxley, LL.D., F.R.S., &c. Ordinary Councillors—J. S. Bristowe, M.D., President of the Society of Medical Officers of Health; Sir Wm. Gull, Bart., M.D., D.C.L.; Rev. Harry Jones, rector of St. George's-in-the-East; Hugh Leonard, late Engineer-in-Chief, Bengal Presidency; F. Clifford de Lousada, retired commander R.N.; Sir W. Tyrone Power, K.C.B.; E. C. Robins, F.R.I.B.A.; Professor J. S. Burdon Sanderson, M.D., LL.D., F.R.S.; Professor Alex. W. Williamson, F.R.S., &c. Honorary Standing Counsel—Alfred Wills, Q.C. Honorary Treasurer—T. Holmes, M.A. Cantab., Surgeon and Lecturer on Surgery to St. George's Hospital.

The following will be the first paid officers of this association, holding office at the will and pleasure of the Council:—Consulting Engineers—Fleeming Jenkin, F.R.S., M.I.C.E., Professor of Engineering in the University of Edinburgh and Consulting Engineer to the Edinburgh Sanitary Potection Association; and H. C. Forde, M.I.C.E. Resident Engineer—W. K. Burton. Secretary—Cosmo Innes, M.I.C.E., 6, John-street, Adelphi.

A short account will now be given of the

manner in which the system is practically worked. A householder or tenant who thinks of joining the association will write to the secretary, Mr. Cosmo Innes, at 6, John-street, Adelphi. In his letter he will state the nature of the premises in respect of which he wishes to subscribe. He will mention the rateable value or actual rent, and the situation of the house. If the situation be within five miles of Charing-cross, and the rateable value of the house under £400, he will know that the terms of the subscription are £2 2s. for the first year, and £1 1s. for each subsequent year. He may either ask the secretary for further information, or he may at once signify his intention of joining the association as a member, and enclose a cheque for £2 2s. He may, if he pleases, call and obtain verbal information from the secretary. When a member joins he incurs no liability, except for the first two guineas. He may or may not pay any subsequent annual subscription; but it is hoped that most of the members who join will remain members of the association, since otherwise they will not receive the full benefit of the scheme. As soon after the member has joined as circumstances allow, the secretary will write to the member, and inquire when it will be most convenient to him to have his house inspected. When the inspection is arranged, the member will be asked to let his plumber meet the inspecting engineer, and also to have the ground opened up in such a manner as to expose the main drain of the house at some point between the house and the town sewer. If the extra expense which this entails is objected to, the inspection cannot be thorough, but may still be useful. The sums paid for opening up the ground do not pass through the hands of the association. Unless some grave defect is discovered in the drain under the house, the opening up of the drain, being done outside the house, need cause no inconvenience to the inmates. The engineer inspects the condition of the main drain, and, assisted by the plumber, takes notes of every pipe, trap, and sanitary convenience in the house; he makes inquiries as to smells and ventilation; he examines all cisterns and arrangements for water supply. When this is practicable, he tests the condition of the pipes by pouring paraffin, or some other volatile strong smelling substance, into the drainage system from the roof. If the smell can anywhere be detected inside the house, a flaw is thereby indicated; this is then laid bare. As soon after the inspection as may be, the member receives a detailed report, describing the condition of his house, accompanied by a sketch diagram showing every pipe and trap; recommendations for improvements are made when necessary, as is usually the case, and some rough estimate can be given of the probable cost of those improvements when this is desired. The improvements recommended are those only which are shown by every-day experience to be necessary. The wishes of the occupier are taken into account, and the more important are distinguished from the less important alterations. The recommendations made are sufficiently specific to enable the member to obtain an estimate from his plumber or builder of the cost of carrying them out. The cost is often considerable, but the member may feel assured that the association has no interest whatever in recommending any expenditure.

The interest of its officers is in the other direction. The less that is done to a house, the less trouble they will have. The less that is done the more popular the association will be. It is, however, only fair to state, that, in the great majority of cases, subscription to the association leads to an outlay in the first year largely in excess of the annual payment. This outlay does not pass through the hands of the association. If the member decides to carry out the recommendations made, or any of them, and gives the secretary notice of his intention, arrangements will be made to inspect the work when completed, or nearly completed. This inspection of the plumbing and other work is one of the most valuable privileges which the member obtains by joining the association. When the alterations have been satisfactorily completed, the member can, on application, obtain a certificate as to the sanitary condition of his premises. This certificate will be of great value to hotels, lodging-houses, and schools. The recommendations made to members invariably include such arrangements as will preclude the necessity for ever again incurring expense in opening up the drain for inspection.

At this point the writer feels that probably all present believe more has been promised than can possibly be performed for the money. This feeling will not be least strong among those best qualified to give an opinion. The writer can, however, speak with the authority of complete experience. It has been shown that these services can be rendered in a thorough and efficient manner, by one resident engineer, for 450 houses or even 500, in one year. The reports, sketch diagrams, and letters in Edinburgh are open to the inspection of all whom it may concern. During three years there has not been one case of complaint that the houses were not thoroughly examined, or that the reports were not sufficiently detailed. At the annual meeting, member after member has risen to express his sense of the thoroughness of the work, and Scotsmen are not easily deluded or even satisfied on this point. At the outset the writer could only plead his own conviction that the work could be done. He is now able to say that, in 1200 cases, it has been done.

The second inspection is a much simpler matter; when the guinea for the second year has been paid, the resident engineer visits the premises, assures himself, by ocular inspection, that there is a free outfall of sewage; paraffin or its equivalent is again poured into the drainage system, and a thorough search made for dry traps, broken joints, or worn-out lead. If the pipe under the house has been laid afresh, in accordance with the association's specification, it can, if necessary, be tested, to ascertain whether it remains water-tight. Inquiries are made as to any alterations which may have been made since the last visit. The condition of the cisterns is examined. The member then receives a second report, in accordance with the facts of the case. This practical and experimental inspection is repeated year after year; it entails no cost beyond the guinea, and no inconvenience. It renders the member practically secure that no imperfection in the drainage system can remain long undetected. More frequent inspections could be arranged for at cheap rates, in special cases, such as schools, where injuries are more likely to occur. The association, therefore, does

peal only, or even mainly, to those who have to believe that there are grave defects in houses. Its chief business begins when the is in good order. The householder is then position analogous to that of a manufacturer as bought a good steam boiler; he knows e apparatus is good, but liable to decay and gement; he employs the principle of co-ion to obtain skilled supervision to protect rom the consequences of that decay or de-ment. A less measure of inspection than is d will not protect a house from the dangers rable from the system of water carriage for e.

re are other minor functions which the ation will fulfil.

will examine plans of projected buildings for ects and builders. This provision is taken tage of to a considerable extent in Edin-.

association will also examine houses for s who propose to take them on lease, or for rds who propose to let houses.

member desires a report on the condition of other premises than his own, such as lodgings ied by the poor, a report will be made at rate rates, as a matter of special arrangement. ese reports are strictly private and confidential. will be seen clearly that the association does ng which might not be undertaken by a single endent engineer; where householders already y an engineer in a similar capacity, and are ed with his work, they will gain nothing by g the association. To the public in general, ouncil of the association, by the knowledge osition of its members, affords a guarantee he officers by whom the advice is given, and spection made, shall be skilled and honour-ersons. Moreover, it is the duty of the con-g engineer to make sure that the principles ich advice is given are sound, and also to that the resident engineers carry out their in a zealous and thorough manner. The ary, also, can aid in watching over the resi-engineers, and in our present association he be specially qualified to do this, for Mr. is himself a member of the Institution of Engineers, and has had large experience of engineers' work. The writer will gladly r any questions as to points which may not, have been made clear to the meeting.

ore concluding, it may be well to answer by pation some of the objections which were to the association when it was first pro-in the North, and which might possibly be ted here. Some people refused to give it countenance, on the ground that they did not e anyone knew anything about sanitation. is no answer to this objection. Then the assertion that if any one knew anything these subjects it was the family plumber. y be admitted with satisfaction that some ers now really have the knowledge which les them to give advice to their clients. It be expected that this will more and more to be the case; but the association will meet ants of those persons who have not complete ence in the plumber; indeed, even if all ers were thoroughly educated, and thoroughly orthy, it would still be desirable that, like all other contractors, they should do their work under professional inspection. Even the late Thomas Brassey—and no name could be mentioned which commands greater respect—was in the habit of saying that it was better he, as contractor, should work under inspection. The interests of the tradesman are not those of his employer; the employer himself has not the technical knowledge which would enable him to control the plumber. The association steps in, and gives the necessary professional assistance. Here it may be remarked that at first the plumbers and builders in Edinburgh viewed the association with some suspicion, and in certain cases with dislike. These feelings have entirely disappeared. It was found that the association led to the execution of more work than would have been done without its suggestions, and that the impartial inspection of its officers was a positive benefit to those tradesmen who did good work.

To continue the list of objectors; a considerable number of persons admitted that the work was both necessary and possible, but asserted that the means provided for carrying it out were inadequate. The inspection would not be real or thorough; and that a sham inspection was actually worse than none. This last proposition must be granted at once. Fortunately, experience has shown that the fears expressed were groundless. If testimonials were wanted from members, they could be had by hundreds. As another proof, the very list of clients might be annexed; these include several of the leading engineers in Edinburgh, Messrs. E. Blyth, B. Blyth, H. Blyth, G. Cunningham Leslie, T. Stevenson, the Royal Bank, the Union Bank, British Linen Bank, the Incurable Hospital, Chalmers Hospital, the Sick Children's Hospital, the Maternity Hospitals, the School Boards, and many other public bodies. The writer is certain that no person acquainted with Edinburgh will state that the inspections, as now conducted, are shams. Perhaps the fear was grounded on a complete misconception. The association makes no pretence at putting badly-drained houses into good sanitary condition for one or two guineas. The improvements must invariably cost a considerable sum—twenty, forty, fifty, even a hundred guineas; in some cases, twice that amount.

The next class of objectors said the association would do too little—that it should not merely give advice, and inspect plumbers, but should itself do the work. It is not denied that an opening exists for plumbing establishments in which the principle of co-operation might be taken advantage of; but this is not, and cannot be, a branch of the present association. To execute plumbing and building, capital is required. If it undertook work, the association would become an ordinary trading company, with the risks and profits incidental to trade. It would no longer be an association of public utility, giving disinterested advice, but simply one more shop competing with other shops.

The next opponent admitted that the objects aimed at were of great importance—of such importance, indeed, that, in his opinion, they ought to be carried out by public authority, and not by a mere private association. So far the writer agrees

with what was said, but the conclusion is surely false, that we ought not to do anything for ourselves which Government might possibly do for us. A considerable number of persons declined to join the association because they thought it weakened the claim of the community to have that done by compulsion and taxation which the association carried out by the voluntary principle. The writer respects the heroism of those who die as martyrs, and let their children die, in unhealthy houses, rather than have these made healthy by a means which they deem impolitic—but he thinks their reasoning unsound.

In this country, custom precedes law, and no better laws are made than those which recognise and extend good customs. If we can show that, at small expense, a thorough inspection can be carried out in the houses of the well-to-do, that this inspection is needed, welcome, and effectual, we shall greatly strengthen the hands of those who would extend that inspection down to the poorest hovel in the town, an object in which they have the heartiest sympathy of the writer. This association is probably only one step towards a general compulsory inspection. When this is established, the association may either cease to exist as no longer needed, or continue to exist, as supplying a better and fuller inspection than that provided by law. Meanwhile, no one need hesitate to join, from any fear that, by so doing, they would weaken the case of those who would forward improved sanitary legal measures.

Next in our list of opponents came those who said the law already provided all that was required —that, in Edinburgh, the medical officer of health and burgh engineer, and, in London, the medical officer of health, the inspector of nuisances, the local surveyor, and the surveyor appointed by the Metropolitan Board of Works already gave, or could give, gratis all that the association promised to give for a guinea. It is quite certain that the ratepayers have privileges of which they are largely ignorant, and of which they very seldom avail themselves. It is also certain that, in most cases, these public officials are obliging and zealous in giving their services when asked to do so: but it is equally certain that neither in Edinburgh nor in London is such a systematic inspection as the association offers carried out by law. If the public could and did insist upon such an inspection, the public staff would have to be increased ten or twenty fold. The writer will not be so bold as to give the smallest opinion as to what the rights of the ratepayer may be under the Metropolitan Local Management Acts, but it is notorious that the inspection which the association offers does not at present exist.

Next in the list of antagonists came those who looked on the association as a body inflicting a slur of some kind on the public authorities, or as established to supply some defect in their action—even as a disgrace to the town itself; for they urged, if the town had good sewers, your association would be of no use. Perhaps the best answer to those who agree with these gentlemen is, that the chief public sanitary authority, the convener of the Public Health Committee, is himself on our council in Edinburgh, and that the President of the Society of Medical Officers of Health is on the council of our society in London. Our work does not clash with that of the public authorities; we begin where they leave off; inside houses which, unless some nuisance is reported, they have, probably, no power to enter. If sewers were all as perfect as sewers can be, the need of annual inspection would be diminished, but would not be ended. Bad sanitary fittings in a house may render nugatory all attempts to isolate cases of infectious illness occurring there, and this will remain true when every town sewer is perfect.

No one came forward in Edinburgh to say that the association was competing unfairly with professional men as sanitary advisers. This has been said in London, but the grounds of the accusation are not clear. The resident engineer is paid at the rate common for men of his standing. The consulting engineer receives a fee which, having regard to the call on his time, is remunerative.

All these objections experience has shown to be of no value, but there remains one objection which will always be serious. Persons shrink from becoming members because they fear that by enrolling they will be led to expend a considerable sum of money in sanitary improvements. "I do not mind the two guineas," they say, "but I shrink naturally from the fifty guineas which this may entail." The objection is valid, but yet it sounds strange when it is urged by a person who says, "I know my house is in very bad order; it was built long ago; rats abound; smells pervade, and we are much troubled by sore throats." What expenditure of money is justifiable if not that which tends to secure good health? No doubt the hesitation is partly due to a doubt whether the sanitary engineer really knows anything at all about the matter. The association does its best to remove that doubt; the reports explain what is wrong, why it is wrong, and what will put it right. The member is left to his own common sense as a guide whether he will follow the recommendations made. It is a matter of no pecuniary interest to his adviser whether the job is done or not, and that adviser is selected and watched by a council, consisting of men as well qualified for this purpose as can be found in London.

APPENDIX.

The following documents, consisting of the provisional rules of the London Association, and the balance-sheet of the Edinburgh Association, are given here for the information of those who may wish to found associations of the kind in other parts of the kingdom or abroad:—

I.—PROVISIONAL RULES.

Objects of the Association.

The objects of this association are twofold:

1. To provide its members, at moderate cost, with such advice and supervision as shall ensure the proper sanitary condition of their own dwellings.

2. To enable members to procure practical advice, on moderate terms, as to the best means of remedying defects in houses of the poorer class in which they are interested.

No obligation will rest on members to carry out the recommendations made to them.

The association is not intended as a substitute for a municipal inspection, and will not conflict with the public authorities, but will supplement their action. Thus it is not proposed that the association should undertake the superintendence of houses while they are being built, or that it should in any way interfere with the public system of sewers.

ADMISSION OF MEMBERS.

Persons become members on payment of an entrance fee, and continue to be members so long as they pay an annual subscription. The entrance fee and annual subscription are regulated by consideration of the annual value and situation of the dwellings in respect of which they are paid.

For ordinary dwellings within five miles of Charing-cross, and of a rateable value under £400 per annum, the entrance fee and subsequent annual subscription are fixed at £2 2s. and £1 1s. respectively for original members. The entrance fee, which may be paid at any time during the year, entitles the member to all the privileges of the association for twelve months from date of payment. The annual subscription is good for the following twelve months. For all other dwellings than those already named, the entrance fee and annual subscription will be determined by the council.

After the 1st of January, 1882, the council shall have power to increase or decrease the entrance fee and annual subscription for new members, but shall not have power to increase the annual subscription of members who have joined before that date.

PRIVILEGES OF THE MEMBERS.

Each member will be entitled to the following privileges:—

1. A report by the engineer of the association on the sanitary condition of one dwelling, with a sketch diagram of pipes, and with specific recommendations, if necessary, as to the improvement of drainage, water supply, and ventilation. This report will be obtainable on his joining the association, or as soon thereafter as may be.

2. The inspection of any alterations in the sanitary fittings, which may be carried out by the advice, or with the approval, of the officers of the association.

3. An annual inspection of his premises by the engineer, with a report as to their sanitary condition.

NOTE.—No single inspection of any premises will secure permanent efficiency. Methodical inspection from time to time is absolutely necessary as a protection against inevitable decay, neglect, and accidental disturbance. Examples of failure where the design was good and the construction originally faultless are of daily occurrence, and are due to such causes as the gradual stopping of pipes and drains by kitchen grease and rubbish, the corrosion of metal pipes, the fracture of earthenware pipes, or the stopping of ventilation openings by dirt.

4. Occasional supplementary inspection and advice concerning the dwelling in respect of which he is a subscriber, whenever this advice may be desired, on payment of a small supplementary fee on each occasion that an officer of the association is called in. The fee for such occasional advice will be fixed from time to time by the council.

5. Reports by the officers of the association as to the sanitary condition of any dwellings designated by any member, or of any plans for proposed buildings, on payment of a fee to be fixed by the council from time to time, with special relation to the rent of the premises to be inspected.

NOTE.—Under this rule intending occupiers, architects, and builders will be able to avail themselves of the services of the association. This rule will also enable members to assist the poorer classes of the community. It is to be understood that no premises will be inspected unless the occupiers themselves assent to the inspection.

6. A vote in the election of the council who manage the affairs of the association. If one member subscribes in respect of several dwellings, he shall have a vote in respect of each.

NOTE.—The association will not publish any reports made to a member. The reports are to be considered confidential, and in using these reports each member must act on his own responsibility.

MEETINGS.

A meeting of the association will be held annually in February, at which a council of at least ten members will be appointed, four of whom shall at any time be a quorum.

The council shall meet as often as from time to time may be found necessary for the disposal of business, and have power to call extraordinary meetings of the association when they think proper.

OFFICERS OF THE ASSOCIATION.

President and Council.—The affairs of the association shall be managed by a council, who shall receive no remuneration, and who, with the exception of the first council, shall be elected from time to time by the members of the association from among their own body. The council shall, from their body, elect a president and a vice-president, whose business it shall be to preside over the meetings of council.

The council shall have power, from time to time, to frame bye-laws for the better administration of the association, and to extend its influence, but not to alter the general objects of the association. The council shall have power from time to time to determine the area of operation of the association in such manner as may seem to them best fitted to promote its objects.

The council shall appoint, and shall have power to dismiss, all paid officers of the association. All expenditure of the funds of the association shall require the sanction of the council.

All paid officers shall hold their appointments at the will and pleasure of the council.

The permanent officers shall consist of a consulting engineer or engineers, a resident engineer or engineers, a secretary, and a treasurer. The appointments of secretary and treasurer may be held by one person.

Consulting Engineer.—The consulting engineer shall, on his appointment, declare that he neither has, nor will acquire during the term of his appointment, any interest in any patent or manufacture connected with sanitary appliances.

He shall give advice to the council and resident engineers, when required to do so, both as to general principles and particular cases presenting any difficulty. He shall, subject to the approval of the council, lay down the general rules, to which the specific recommendation of the resident engineer must in all cases conform. His remuneration shall be fixed from time to time by the council.

Resident Engineer.—Each resident engineer shall, on his appointment, declare that he neither has, nor will have, during the term of his appointment, any interest in any patent or manufacture connected with sanitary appliances. The salary of the engineer will be paid by the association, as may be fixed from time to time by the council.

The resident engineer shall, in all cases, report in writing, and submit his report to the secretary, who, unless he sees reasons to the contrary, will transmit the same to the member interested.

The resident engineer shall not, as an officer of the association, recommend to the members the employment of any builder, plumber, or other tradesman. He shall not recommend to the members the employment of any patented appliances, unless these shall have met with the approval of the council and the consulting engineer.

Secretary.—The secretary shall, on appointment, declare that he neither has, nor, during the term of his appointment, will have, any interest in any patent or manufacture connected with sanitary appliances. His salary shall be fixed by the council.

The secretary shall keep such books and forms as the council shall from time to time direct, and he shall have the superintendence and charge of all the minute books, letter books, lists, and registers, belonging to the association, which registers shall contain a summary of the communications. He shall keep the minute books of all meetings of the association and of the council. He shall also keep a register or list of the titles of all communications which shall have been received, in the order of the dates when these shall have been so received. He shall prepare, and cause to be issued, printed circulars to all the members resident within four miles of Charing-cross, and to all such members, resident in the country, as may express a wish to have circulars sent to them, at least two days before each general, ordinary, or extraordinary meeting, containing the programme of all business to be brought before each meeting. He shall conduct the correspondence of the association in accordance with the rules which may from time to time be laid down by the council. He shall obey the instructions of the treasurer in all matters relating to finance. Copies of the reports and plans shall be submitted by the secretary to the council at each meeting, and shall at all times be open to the inspection of the members of council and the consulting engineers.

Treasurer.—The treasurer, or some person appointed by him, shall receive for the use of the association all sums of

money due or payable to the association; and shall pay and disburse all sums due from or payable by the association; and shall keep particular accounts of all such receipts and payments.

Every sum of money payable on account of the association exceeding £5 shall be paid only by cheque signed by the treasurer and one other member of council.

All sums of money, which there shall not be present occasion for expending, or otherwise disposing of, to the use of the association, shall be deposited in a bank, or laid out in such Government or other securities as shall be approved of and directed by the council.

The treasurer shall demand, or cause to be demanded, all arrears of annual payments as they become due.

At each meeting of the council a statement of accounts shall be laid on the table by the treasurer.

The accounts of the treasurer shall be audited annually, a short time preceding the annual general meeting, in such manner as may be directed by the council.

As soon after the audit as may be, and before the annual meeting, the treasurer shall cause an abstract of the association's accounts of the preceding year to be printed for the use of the members.

II.—ACCOUNTS.

Balance-sheet presented at the Second Annual Meeting of the Edinburgh Sanitary Protection Association, March 30th, 1880:—

Charge.

Balance at the Credit of the Association on 18th March, 1879				£29	18	8½
Annual Subscriptions received for the year from 18th March, 1879 to 18th March, 1880—						
412 at £1 1s. each	£432	12	0			
26 at £2 2s. upwards	70	7	0			
Sum,				502	19	0
Interest on Bank Account to 31st December, 1879				1	10	2
Sum of the charge				£534	7	10½

Discharge.

Salaries of Officials—						
To Professor Fleeming Jenkin as Consulting Engineer				£52	10	0
To Mr. Welsh, Resident Engineer—						
One month at £150 per annum	£12	10	0			
Eleven months at £170 per annum	155	16	8			
				168	6	8
To Captain Douglas, as Secretary				100	0	0
Sum				£320	16	8
To Tradesmen for assisting Resident Engineer at Inspections				11	14	5
To travelling expenses of Resident Engineer				1	8	9
To Office Rent and Taxes				87	18	10½
To Stationery				6	11	1
To Advertising and Printing				38	16	0
To Furniture and Removing Office				10	9	1
To Collector's Commission at 5 per cent.				6	7	6
To hiring Masonic-hall				1	1	0
To Charwoman for year				11	12	0
To Postage and Sundries				14	8	7
Sum of the Discharge				£460	18	11½
Sum of the Charge				534	7	10½
Balance in favour of the Association				£73	8	11

"Edinburgh, 30th March, 1880.

"I have examined and audited the foregoing account, and I have found it to be properly and sufficiently vouched, and correctly stated, and there is a balance of £4 7s. 6d. due by Captain Douglas, as on the 19th March current. I have prepared an abstract of the accounts, to which I beg to refer, and from which it appears that, in addition to the above balance, there is also a balance due by the bank of £69 1s. 4d. "Thomas Scott.

"30th March, 1880."

DISCUSSION.

The Chairman, in inviting discussion, indicate as briefly as possible how his nar placed in the honoured position which it head of the association. He felt in that p thing like the proverbial "fly in amber," b extreme stretch of the term "natural histor of which was his proper business, he did sanitary inspection could be included in it. rest of the world who had any knowledge gical matters, or any conception of the la had always taken a sort of theoretical int tions of sanitation; but there was a wi between a theoretical and practical inte was brought home forcibly to his three years ago, when suddenly, with three of his children were struck do theria, and one of them lay a long time and death. This was a lesson which turn tion more strongly to the importance of th sanitation than all the mere talk about it heard. He became deeply interested in condition of his own house, which was well situated, and in which, he thought, precautions had been taken. It turned investigation of the history of that very demic, that it was not his house which w all. His children were poisoned through most careful inquiry, which was made a the officers of health, left a keen convictio —although the evidence did not exactl proof—that the fault certainly did nc house, or in those of a large nu neighbours, who were many of them mu with by the epidemic than he was, but th of the whole mischief lay in a prepostero to the conditions necessary to be attended draining a large and populous district. I of pains with the question at the time, that if ever he could serve the cause of any way he would do so, and would do could to bring before the mind of the pul amount of vividness which was necessary unless sanitation was attended to in like London, before long they would be diseases introduced, by their own contrivi own houses, on a larger scale, probably, cities of old by plague and pestilences of He was glad to be able to do anything fact before the minds of the people of L get them to do as Professor Jenkin had take ordinary means for protecting them looking for extraneous help. It was o that he had consented to join the comn only regretted that the council had thou him forward as their representative and c could not do much in that capacity, but to say that when once the society was in there would not be very much for eithe council to do; at any rate, what little which he could do, should be done to t ability.

Sir Henry Cole, K.C.B., thought every o that if they were to get sanitation in Lon do the work themselves. He had had s perience of Vestries, and he saw no salv He had been before the Metropolitan Bo was politely asked if he ever read Acts as there were such extensive powers for thing right. He had been to the Pr Local Government Board, and pointed ou the street in which the present Prime had been found to have half its house with the sewer at all, and all he got was sympathy. The Society of Arts had bee

...er for the last seven or eight years, in the only ...ould, and at last it had actually done some... The present Council having determined to ...ne additional conveniences to the members, ...an expert to inspect the premises, who ...n, as they expected, that their sanitary ...nts were as bad as could be. The Society ...as a pioneer in this work; it undertook to ...public, and afterwards to give lessons to ... Parliament; and, to some extent, there... ...night claim to have helped on Professor ...eme. There was, however, more than one ...the field. Going back a little, Mr. Cresswell ...forward there the idea of a sort of sanitary ...hich people might insure; then came the ...ork, and then came the Parkes' Museum ...; then there was the Sanitary Institute, ... Health Society, and a Ladies' Sanitary ...He enumerated these to show what a deal of ...required before you could get up enthusiasm ...arry anything into operation. Earlier than ...se there were Dr. Farr, Mr. Chadwick, and ...er now present (Mr. Rawlin on), who went ...imes to help to make the troops a little ...than they would have been without him. ...ncil of the Society had it under considera... ...offer three medals to the proprietor or ...who should produce three good houses in ...which should be held up as illustrating the ...anced opinion on correct sanitation. No doubt ...uld be some difficulty in the matter, but the ...ind would be thus directed in the right road. ...no use going to Parliament until they could ...isten, and that would not be until constituents ...nt the country insisted on their members pay... ...ition to the question of health.

...Rawlinson, C.B., said he most heartily wished ...d to the association now started, which he had ... would do a great deal of good. Professor ...ad mentioned pipes within houses, traps, and ...; but when houses were dealt with as they ought ...re would be no drain-pipes within them, and ...would have very little, if anything, to do with ...t was quite possible so to arrange the largest ...that there should be no drain-pipe within its ...walls, and no need for the intervention of any ...The whole of the apparatus might be of iron. ...nd to improvements, he would only say that ...times the Egyptians called in experts to em... ...bodies of their dead, but when they had per... ...he operation, they had to escape for their ...d he feared that the sanitary engineer ...ed upon somewhat in the same light. ...lled upon to advise, but if he were an honest ...the premises were in a very bad state, it was ...necessary that he should turn them inside ... necessarily cost a large expenditure of time ...; and caused a great deal of personal incon... ...and he could assure the meeting that the ...r cordially hated that man by the time he ...his work. Before that association or any ...d, he had probably done as much gratuitous ...this kind as anyone, for he never ...respond to an application for advice on ...tters, from any person who came to him ...oduction from a personal friend. But he had ...found that persons possessing wealth set ...re by it, and thought so little of their own ...afort and health, to enable them to enjoy ...that they put away the idea of spend... ...siderable sum, and suffered the rats, and ...and the rot to go on, and went to their ...ey had begun. There was now a great ...mongst the dry bones of ignorance through... ...l, and a paper of this description, when dis... ...ideast, was calculated to do a great deal of ... had no doubt the association also would do good. The apathy in this matter more frequently came from the father than from the mother, as he was not within the building perhaps more than five or six hours out of the twenty-four, and they who suffered most from the bad arrangements were the delicate children, ladies, and those who were living on the premises. One after another the children might be seen falling into consumption, and fading away before a father's eyes; but he might be ignorant of what was the cause, and let evil go on day after day. He (Mr. Rawlinson) would tell them that, according to his experience, the cause of ill-health throughout the length and breadth of the civilised world, even in malarious districts, was not so much in the atmosphere, not so much in the earth, not so much in the swamp, as in the habits of the people, and in their foul dwellings. Probably he could speak with as ripe a knowledge as any man. He was a member of the Army Sanitary Commission—a body of which the public knew nothing. The Quarter-master-General of the Army, for the time being, was always the chairman, and it included besides the Second Medical Officer of the British Army, the Royal Engineer quartered in London, the Chief Medical Officer from India, and one of their chief engineering officers. They had returns coming in regularly. Wherever a British soldier was quartered on the face of the earth, they had returns as to the climatic influence and the conditions under which he was living, so that he (Mr. Rawlinson) was justified in drawing the conclusion he had mentioned, that it was not so much the climate as the conditions of life which made the difference. As the meeting was aware, he was one of a Commission sent out to the Crimea, where such a mortality prevailed as had never previously been known. The Russian retreat was not so bad; the Walcheren expedition was not so bad. Some regiments lost 700 men out of 1,000 in three months. The Commission found those hospitals reeking with filth — the men living under the worst possible sanitary conditions. Some persons blamed the military and medical authorities, but they really were not so much to blame, because those wonderful regulations, which were tied up with red tape, prevented anything being done. The Commission to which he belonged went out, however, entirely unfettered; their instructions would be found in Kinglake's last volume, and that author spoke most highly of them. So did the American Sanitary Association, which was founded on the model of theirs. They were not fettered in what they ordered or what they expended, and the result was that, by simply carrying out cleansing operations, in three months they brought the mortality in those hospitals down from about 15 or 16 per cent. to 1¼ per cent., and by the end of the summer the entire British army in the Crimea was healthier than ever it had been in barracks at home. At this moment he might say broadly, that whereas previously to 1858, the returns showed that the army had suffered at the rate of 17½ per 1,000, and in India, 69 per 1,000, since improved sanitary regulations had been carried out, the mortality at present was less than 7 per 1,000, and, in India, less than 20. He had not a shadow of doubt that London, wonderfully healthy as it was, might have its mortality considerably reduced, and he would give a case in point. In Leeds, some years ago, he found the sewers were not ventilated, and the rate of mortality was high. Fortunately, they had now an exceptionally intelligent engineer, and he had done what ought to be done generally; he had not only ventilated all the main sewers, but he had untrapped every gully. The result was, there were 20,000 gullies which had no traps, and the combined area was equal to something over 3,300 square feet always open to the atmosphere. By the last returns, the mortality was reduced to about 19·9, whereas last year it was 25·5. If there was one thing more difficult than another, it was to induce people to ventilate the sewers and drains.

There were towns which persistently bottled up their sewers, because if they made one opening, they said it stank so abominably—and so it did—that they shut it up again, instead of opening 20, 50, or 100 others. He had recently reported on Dublin, which had 400 ventilators on their main sewer, whilst he ascertained that to make them safe they ought to have 2,800. This question was at the root of sanitary improvement. Any house having drains within the four walls which had openings into them was not in the condition it ought to be. If a drain must traverse the basement from back to front, as in many cases it must, he would resort to an iron pipe. with a ventilator behind, he would cut it off the main sewer in front, and bring the communications with the sinks and closets into it outside the walls.

Mr. C. N. Cresswell said that every lover of sanitary progress must sympathise with the efforts of Professor Jenkin and Professor Huxley, to promote the real well-being and health of the people; and, of course, those who had been conspicuous in that Society in the promotion of the good cause, rallied to support an excellent effort, however small it might be compared with the magnitude of the evil with which they had to cope. With that view he had come over from Paris to pay his small tribute to the man who had come from the seat of learning in the north to help Londoners in the cause they all had at heart. But he must confess that he was somewhat disappointed by the almost insignificant proportions of the weapon with which it was proposed to deal with the enemy. It was a very thin end of the wedge, and he cordially agreed with the remark of Professor Jenkin that it was probably only one step towards general compulsory inspection. In that sense he welcomed it, and if it tended in any way to serve that cause it was worthy the support of every lover of his country. The very title of the association showed that it must be of very limited operation, and, by the rules, it appeared that it was confined to domestic sanitary protection. Now, sanitation was a very large subject, and went far beyond the limits of the mere household. There were other causes, other evils to which attention had often been called there, which he wished some grand association might be promoted to deal with and repress, and, therefore, he felt that, surrounded as they were by a most unsanitary atmosphere, physical and moral, on this subject, it would have been well if the association had been so formed as to enable it to deal with the difficulty in a far more radical and drastic mode. However, it would be ungracious to pursue that line of argument any further. They ought to be grateful for even the smallest mercies, and to thank those who came forward with their time and scientific reputation to assist. But after all, how little could they do in such a metropolis as this. During the three years the association had been in operation in Edinburgh, admirably organised and well supported, they had succeeded in dealing with 1,200 houses only. In London he believed there were 400,000 or 500,000 houses; they were increasing at the rate of 60,000 to 70,000 per annum, and out of those new houses built every year 50,000 were unfit for human habitation. That showed the evil with which they had to cope. Some allusion had been made to his own efforts; he had the honour in June last of propounding a scheme which should have the sanction and co-operation of every County Board—such as they might have some day—every municipal authority, and every public body which had the right to exercise such powers as would be necessary; he had the support of the Right Hon. Mr. Stansfeld, Dr. Richardson, Dr. Voelcker, authorities recognised everywhere, and the unanimous approbation of a crowded meeting, and what had been the result? It had been absolutely ignored as far as public opinion went; nobody condescended to notice it. Possibly the seed he sowed was bad; possibly it fell on barren ground; possibly it was choked with the weeds of *prejudice; possibly it was not watered with what was* necessary to growth in anything—a strong lar public opinion; but from one cause or "unmarried ere it saw the sun." This eff it had fallen—died, as Shakespeare said of the pr hoped, might have a more prosperous career. were to have County Boards in Ireland, and, p when Irish affairs were settled, they might hav in England; and it was through County Boa great municipal bodies he hoped to see some step taken even than this. The first step w an attempt to supersede the miserable apolog government called the Metropolitan Board o and the Corporation of London. Let them seek the metropolis a form of government foun common sense, and invest the governing body w power to compel, in the sense of passing laws to every householder to obtain that which he de and every municipal right to enforce that wh absolutely essential for the welfare of the public

Mr. J. I. Tracy advised people not to rely on prof aid, but for each one individually to look a own interests. He considered that great engin surveyors had done an immense deal of mischi works they had carried out.

Mr. Rogers Field agreed in the main w Rawlinson's remarks. The point he felt a d about was the possibility of giving adequate ins for the terms mentioned. His experience show work of this character required a great deal of tim careful inspection throughout, and unless it thoroughly well done, harm instead of good result. He gave an instance where he had been cal after a case of typhoid fever; but his recommend were not fully carried out, on account of the ex and the consequence was that fever again bro Eventually the work was thoroughly done, a house became healthy; but if it had not been co pleted, it would have been said, "You called surveyor; you spent a great deal of money, a house is as bad as ever;" and he could not i anything more likely to injure sanitary scienc such a state of things. Since then he had ma rule, if his clients would not do what he con necessary, to have nothing to do with the case.

Mr. E. C. Robins did not sympathise with t marks of Mr. Field, who did not seem to underst principle they proposed to act upon. He s Professor Jenkin had shown that the househ difficulty was, not that he did not know some principles to be observed, but he did not know apply them. It was an expensive affair to call Field, and there were thousands of people who not afford it, but were they not to have good ad all? They were not responsible for people not good advice, or stopping in the middle of a j saying they would not do any more. They owed of gratitude to Professor Jenkin for showing th ticability of this scheme in Edinburgh, wher houses had been put into good order under the vision of the society, who charged no more th guinea, or two at the outside. That was th wanted in London, and the more they had of better. There were plenty of practical men he to carry out the instructions given to them; the some honest tradesmen, and it was a false conclu come to, to say that nothing effectual could b unless there were perpetual inspection by highly surveyors. He had had as much experience as m of bad work, and knew how important it was th should be that proper participation between mas man, which would make them all feel interested i ing out the work in the best possible way. I had personal experience of the usefulness Edinburgh Society, for his friend, Professor Fi St. Andrew's, got their engineer down to ins house, and had the recommendations carried

rkmen; it was afterwards inspected, and any set right, and the result was most satisfactory. hope, therefore, that the plan would receive all ntion it deserved.

Waters said this subject was of the greatest im-e, and perhaps medical men could speak on that more strongly even than engineers. It was not reat diseases which were brought into the house itary defects, but minor affections, such as head-, sickness, diarrhœa, &c. It seemed to him, how-that the scale of payment was scarcely adapted to lon, as well, perhaps, as to Edinburgh. A house 600 a year, near Charing-cross, would be much ler than one of the same rent five miles away, and amount of work to be done would be very different; the same fee was charged. He was a director of ilar society, which based the fee charged on the er of water-closets in the house, and this he con-d preferable.

White gave a practical instance of the usefulness association. He knew a house which had been most unsanitary state ever since it had been and he was advising the occupants to give that they should not continue in it un-as put into a sanitary condition, to the satisfac-the engineer of the association. He had felt for many years the helpless condition in which were placed with regard to these matters; he and again endeavoured to get landlords to set ight, but they had shirked it. It would be ome to them practically if they received notice tenancy would not be continued unless their e put into a sanitary state. He could not but in a few years, the association having shown ess in a small sphere, it would by degrees stries and Local Boards to take up the question, ish local associations of the same kind in each hich would do the work which one body could ver so large an area as London.

lliam Botly wished to say a word in corrobora-e views expressed by Mr. Rawlinson. In ouse he had had all the pipes removed from , and the water-closets also put outside. The stimate was £25, but improvements were made rse of the work, which brought it up to £72 ; but no money was ever better laid out.

I. Collins, having had 26 years' experience with of buildings, could only come to the same con-Mr. Rogers Field, that the fee charged was adequate for anything like a proper inspection, a skilled workman. That very day he had ecting a house of about £150 a year rent, and e drainage had been laid open on the previous ok him from nine in the morning until half-in the afternoon in order to get the data is report, the writing of which and preparing would occupy him three or four hours more. It sible for a professional man of any standing work for anything like the sum named. It ry well to have theory, and you could not do , but in these matters you also required prac-extensive experience, for nearly every house m peculiar conditions. No young man would ant to deal with such matters satisfactorily, name of an eminent engineer were attached which he had not been personally prepared, it lly do more mischief than good in the end.

leeming Jenkin, in reply, said he had endea-avoid anything which could be called sensa-scribing the evils under which they laboured, e knew that every one present there, at any fully sensible of those evils. With reference wlinson's remarks, he could only say that the attempted to deal in the first place with ey were; they had to look at houses as they existed, with a good many pipes inside them. If they came forward and told every householder that all those pipes must be taken out, very few people would consult them, and they would not do nearly so much good as they might. There might be a good many healthy houses in which there were some pipes, although he cordially agreed with the principles laid down, that if you were to design a new house, the mode suggested was the proper one. In reply to Mr. Cresswell, he could only say that the associa-tion was a modest one; it did not propose to do every-thing; but only something—and something practical. There was only one point in the description to which he felt it necessary to seriously address himself, and that was the one raised by Mr. Field and Mr. Collins. It was one he had answered to some extent by anticipa-tion, because he expected it. Mr. Collins was present at the meeting of the Social Science Association at Edinburgh, and he (Prof. Jenkin) also came there from abroad for the purpose of discussing this very question. The association had been started in Edinburgh, where he was known and, to some extent, trusted, and the same difficulty was raised at the outset, but a great many people put some confidence in him, and that confidence had not been misplaced—at any rate, no one had made any complaint. He attended the Social Science meet-ing because he thought a great many engineers would come there and hear what had been done, and they would have the opportunity of challenging the success of the association and the thoroughness of the work. Mr. Collins heard his paper read, and heard several persons speak upon it; he heard the opinions of the medical officers of health, and of Sir Robert Christi-son in favour of the association, but no one got up to say the work was not thoroughly done. Mr. Collins did not get up then and say what he had said now, or he would have been met with a very different answer. The books were open to him, why did he not go and look at them? How dare anyone who had had an opportunity of consulting these reports come there and tell him in effect that he, a member of the Institution of Civil Engineers, was offering something which was a sham and a delusion? He had some reputation, and he was not going to stake that reputation on anything he could not support. He did not come to London until the thing had been at work three years in Edinburgh—until he could come forward, not only with a hope which justified him in beginning the work, but with a certainty. He could read any number of letters on the subject, but it would be merely self-laudation. He had done enough to justify him in asserting that they could do good work, small as the price might be. If he did not, he was fully alive to the responsibility he should be incurring by giving a sham inspection, and a sham report, which would be good for nothing, if not worse than nothing. All he could say was, give them a trial; if the work was badly done, they would not be tried again; bad work could not possibly live. Let all associations with the same object flourish; let some charge more and some less: let those who could afford to pay fees to engineers of eminence for personal attention continue to do so, but until some case was proved of inattention or of inefficient work done by that or any other association which worked cheaply, engineers should not get up to say the work would be badly done.

The Chairman then proposed a vote of thanks to Pro-fessor Jenkin. The statement he had made was so clear and definite, that if it turned out to be correct he would assuredly reap the credit which he deserved; while, if it proved incorrect, it was so definite that there could be no doubt about the matter. They might also thank him for the very vigorous and, at the same time, good-tempered defence he had made of his position.

The resolution was carried unanimously, and the Proceedings terminated.

CANTOR LECTURES.

SOME POINTS OF CONTACT BETWEEN THE SCIENTIFIC AND ARTISTIC ASPECTS OF POTTERY AND PORCELAIN.

By Prof. A. H. Church, M.A. Oxon., F.C.S.

Lecture IV.—Delivered Monday, Dec. 13, 1881.

Soft Paste Porcelains, European and Oriental.

Softness, as tested by the file, or by a fragment of quartz (or even felspar), and by fusibility in the kiln, generally go together in the case of translucent wares, usually known as porcelain. No exact classification of these pastes, or bodies (which, after all, are mere mixtures, variously and often capriciously compounded), is possible. But it is not without reason that the glassy, the felspathic, the phosphatic, and the kaolinic constituents which characterise certain wares, should be regarded as determining the species or kind of porcelain to which they severally belong. But difficulties in classification after this fashion are always arising, when one has, for instance, to find a place for such a composition as the soapstone body of early Worcester make, and the glaze-formed porcelain of Persia. A word about the latter, as the only kind of Oriental soft porcelain, and far older than any European translucent ware, may serve as introduction to to-night's discourse. This Persian porcelain occurs almost exclusively in three forms, namely:—(1.) Small white vases, bottles, and cups without other decoration than surface-mouldings; (2.) Open shallow bowls with rice-grain perforations filled in with the glaze, and often decorated with sparse simple lines of black, brown-purple, or blue; (3.) Bottles, cups, and other vessels having a blue ground and lustre decoration. The specimens of the first and second groups, and occasionally those of the third, consist of a highly silicious granular paste, or body, washed over with a small quantity of a kaolinic substance, and rendered porcellanous, and remarkably translucent, by means of the penetration of the glaze into its whole substance from both surfaces. It may be compared to a piece of cartridge paper which has been thoroughly varnished, so far as the cause of its translucency is concerned. It now transmits a great part of the light which falls upon it, instead of regularly reflecting much, and "scattering" (by innumerable small irregular internal reflections) more. This ware has been fired at a low temperature, and shows, wherever the glaze has not saturated the body, how porous and fragile the latter is, and how easily discoloured. Pieces of Persian porcelain, belonging to group 2 above, were known in England as Gombroon ware. There are characteristic specimens both in the British Museum and in that of South Kensington.

Let me now direct your attention to the beginnings of the manufacture of porcelain in Europe. Of course, both hard and soft paste were inspired by the desire to reproduce the delightful material which the Chinese had so long made, and had adorned so exquisitely. The first approximate success was reached in the Medici translucent ware, which dates from 1581. In this three materials were associated, namely, the porcelain-clay of Tretto, near Vicenza, a fine sand, and a glassy frit. *Specimens* are extant at Sèvres, and in some Italian museums. Of the porcelain said t been made at Venice as early as 1519, no aut specimens have been recognised, but some pieces of the period 1720-40 are known; the of a very translucent glassy character. Co the better of two Venetian porcelain mak the later period (1765). It is curious to no the use of binoxide of tin in glass maki influenced much of this Venetian porcelain smooth milky white, sometimes densely aspect, associated with a high degre translucency, is to be attributed to the duction of a stanniferous enamel. At a soft paste porcelain was made in and at Capo di Monte, Naples, in 1736. workmen from the former factory intr the manufacture of soft porcelain into (Buen Retiro) in 1760. On studying the pa glaze of these Spanish and Italian porcela is able to discern in some measure those r between them which are due to the impo of methods, if not of materials, from one another. The soft paste made at Alcora, i differs from that of Buen Retiro, as might pected from the circumstance that its manuf was introduced, not by Italians from Ca Monte, but by Germans from Dresden.

Belgium was somewhat late in the manufa of porcelain, but Peterynck, of Lille, mi plastic clay with a clay marl and a glassy obtaining thus a tenacious and durable paste. "privilege" dates from April 3rd, 1751. factory at Tournay was a success. Marieb Sweden, possessed a small works, where soft porcelain was made. Of these wares, and of which were manufactured at divers small pla Switzerland and Austria, there is little know nothing that I need here mention, for we have to discuss all the more important points nected with such productions, when speaki those which were turned out from English French factories.

And here, perhaps, I may suitably direct you tention to a subject on which much misappreh exists. Although in true hard porcelain, if wi colour, both Oriental and European, a hard and a hard glaze go together, it is not unus find a great range of degrees of hardness in glazes upon the so-called soft porcelains; for, vided the difficulty of unequal contraction be mounted, there is nothing to prevent a soft very fusible glaze, rich in alkalies or lead, being applied to a china body of a conside degree of hardness. So, on the other hand, finds the soft, porous, nearly opaque body of Bow porcelain, coated with a glaze much easily abraded than itself. The one conditio be fulfilled is the greater resistance to the so ing and fusing effect of heat, which the body enjoy when compared with the glaze. It is u ful to bear these facts in mind, when examini piece of porcelain which is said to be "soft pa Ascertain, by a file, or a piece of quartz or fel the hardness of the paste on some portion of vessel free from glaze, and do not be content any signs of attrition which the glaze may s And it may be further noted that the remov enamel colours by wear is by no means a sig the porcelain body beneath being soft paste, points rather to the hardness of the glaze, or t

rature at which the painting on its surface fired.

in returning to the subject of soft paste of foreign manufacture, I would direct ention to the French works, as illustrated pecimens before you. You will notice the nces which the productions of certain f these factories bear to each other. You the remarkable translucency, and almost surface, of the early wares of St. Cloud, and ad the Faubourg St. Honoré, Paris. Here allied products of Chantilly, and Mennecy-y, Orleans, and Sceaux. The employment aferous washes to whiten the body, con-he early Chantilly porcelain with that of A chronological list of the chief French exhibits many points of interest, when epresentative specimens of each side by side.

St. Cloud.	1753. Orleans.
Lille.	1753. Sceaux.
aris: Faubourg	1756. Sèvres.
noré.	1768. Etiolles.
antilly.	1773. Bourg la Reine.
ennecy-Villeroy.	1784. Arras.
ncennes.	

these factories produced good wares, f technical skill, of artistic knowledge, able raw materials, offered in some cases wbacks to assured and permanent suc-works at Vincennes were started about or a few years were engaged in futile s, until about 1745. In 1753, they nised, and in 1756 transferred to Sèvres. or body of the *Vieux Sèvres*, the *pâte* ists of eight parts marl, and seventeen sociated with seventy-five parts of a and covered with a lead-glaze. I give sition of the frit and glaze, that the subsisting between the composition of of soft paste, and that of many English ay be apparent.

es frit consisted, in 100 parts, of—

parts	fused together and then washed.
parts	
a salt 7·2 parts ..	
parts	
·6 parts	
13·6 parts	

es glaze consisted in 100 parts—

d or litharge, 88 parts	fused together and ground.
7 parts..............	
ate of potash, 15 parts	
1 parts	
ate of soda, 9 parts ..	

, after having been baked, was glazed and en the colours were applied by dusting lazed surface, which had been previously th a thin film of fat oil of turpentine. pieces are fired, and the process of the enamel colour is repeated—the g fired again. By repeating these two everal times, the fine coloured grounds èvres was famous, were obtained. The , often marbled and veined with gold, y use; the bleu turquoise was invented nd the rose carné, or Pompadour, the ée, the vert pomme, jaune claire, vert rt jaune, in 1857. The special beauty es lies not in the intrinsic excellence of the enamel colours, though this is high, but in the penetration of the glaze by the enamel ground-colours, and the rich but soft effect thereby produced—an effect which is enhanced by the special qualities of the soft and fusible paste beneath.

From old Sèvres let us turn to old Chelsea, the earlier productions of which show the presence of much vitreous matter, like the soft paste of the French factory. The date of the Chelsea works is not known. As, however, a high degree of excellence had been reached as early as 1745, evidence of this being afforded by the three specimens of "bee milk jugs" known to exist, all marked with an incised triangle and "Chelsea, 1745," engraved in the paste, it is incredible that the manufacture could have originated in that year. We know that in 1747 some Staffordshire potters went to Chelsea, but the notion that any improvement can be traced to this source is obviously erroneous. However, it would appear that they soon left the original factory, and set up an establishment of their own. We have data for arranging the productions of Chelsea according to these periods:—

Period I.—1745 (?) to 1757.
Period II.—1759 to 1769.
Period III.—1769 to 1784.

During period I., the porcelain was characterised by considerable translucency, much glassy grit being employed in the paste, and the glaze being also very soft. During the second period, the colouring was soft and yet rich, but the ware was less glassy, and the glaze rather more greenish. Towards the middle of this period (1764) Nicholas Sprimont, the owner, tried to sell the factory. It was then in most active operation, for a single year's production (over and above private sales) took sixteen days to dispose of by public auction. The catalogue of that auction comprised over 1,600 lots, and more than 6,500 pieces. In 1757, the works slackened and then ceased, the manufacture being resumed in 1759. From that date, all the ware was phosphatic; that is, it contained much bone-ash in the body, while the use of gold in decoration became more frequent and more lavish; figures with gilding upon them are not, indeed, so much as named in the sale catalogue of 1756. Here I may name and show you a peculiarity of the early Chelsea body (of period I.), which was, I believe, first recognised by Dr. Diamond. This white leafy saucer illustrates the characteristic to which I refer. On looking through it at a candle, we notice a number of moonlike discs scattered throughout the piece, and much more translucent than the rest of the body. They seem to be due to an irregular and excessive aggregation, in fact, of the vitreous frit which formed so large a constituent of the early Chelsea ware. Typical specimens of the second period are seen in the large vases (1764) in the British Museum; in the third period, when the works were in the possession of W. Duesbury, of Derby, the style became more ornate, and, in many instances, indistinguishable from that of Derby. Some suggestions as to the materials employed at the Chelsea works may be gathered from the following statements in Grosley's "Tour in London," "the sort of earth fit to make porcelain" was supplied by Cornwall to Chelsea: pounded glass was then used, and sand from Alum Bay. It will be recollected that Dorset

clay had been worked as early as 1666, and the clay of Bovey Tracey as early as 1730. But chemical analysis of authentic specimens of Chelsea confirms the separation I have made of Chelsea china into three periods, which may be respectively designated as—

I. The vitreous.
II. The phosphatic,
III. The kaolinic.

Something more about this will be seen further on.

Let us now turn to another famous English factory, that of Bow. The introduction of the characteristic constituent of what is often called by Continental authorities "natural or English soft porcelain," is usually attributed to Josiah Spode the younger, son of that Josiah Spode who, at first a workman, rose to considerable position and wealth, and who died in 1797. His son soon afterwards began making porcelain, and attained great excellence in smooth uniformity, truth of form, and fineness of glaze. He died in 1827, his partner, William Copeland, having died in 1826. Josiah Spode the third was the second son of Josiah Spode the second, but he only survived to carry on the porcelain manufacture for two years, his older brother, J. Hammersley, being in business in London as Spode, Son, and Copeland. In 1833, S. T. Copeland bought the works at Stoke belonging to Spode; afterwards the firm became Copeland and Garrett.

It will thus be seen that no Spode porcelain can be earlier than 1797, probably not much earlier than 1800. If, then, we find phosphate of lime in porcelain of an earlier date, and of other manufacture, Spode's supposed introduction of bones into English porcelain paste—in fact his supposed invention of "natural or English soft porcelain"—falls to the ground. Now, chemical analysis of many specimens much earlier than any of Spode's make, proves this to have been the case. Bow, Chelsea, Worcester and Caughley, are all alike in this particular—all contain phosphate of lime from bones. The excavations in 1868, at the works of Messrs. Bell and Black, revealed many unglazed fragments and wasters which must have been made on the spot; some of these I have analysed completely, others I have tested; all tell the same tale. The patents speak in the same way. The 1744 specification of Heyly and Frye gives one part of potash, one of sand or flint and unaker. In 1749, T. Frye's patent names, in lieu of unaker (an earth from the Cherokee territory, U.S.), a virgin earth, produced by the calcination of certain "animals, vegetables, and fossils." This is directed to be mixed with flint or sand, and a certain proportion of pipe-clay. The glaze was made of red lead, saltpetre, and sand, with some white lead and smalts. There can be no difficulty in identifying the earth produced by the calcination of certain animal and vegetable matters, as bone-earth, or calcined bones, which is essentially phosphate of lime; but the patentee did not desire to be too explicit. Here are the analytical results confirming this deduction. They are obtained by means of a careful chemical examination of some fragments of unglazed porcelain of obviously early period, disinterred during draining operations at the works of Messrs. Bell and Black, at Bow:—

	Per c
Silica	40·
Alumina, with a little oxide of iron	16·
Lime	24·
Phosphoric acid	17·
Soda	1·
Magnesia	·
Potash	·

The resemblance between the Bow and Chelsea porcelain of the second period is conf by analysis of the latter which I have made. ' have given me about 40 per cent. of silica, a per cent. of phosphoric acid; but the Bow b softer, indeed it may be easily cut with a and the glaze, which takes colours well, is *piqué avec points noirs.* The bottoms of vase cups of Bow are often heavy and uneven quently they have been ground level. Caughley specimens, all Pennington's, Staffordshire, and many Worcester, contain phate of lime, little use can be made of the applied molybdic acid test for phosphoric ac order to determine the origin of a piece of ol paste porcelain.

The Bow factory was an extensive one; ac ing to Craft's well-known inscription in British Museum, 300 hands were there empl It may have been established earlier than the of the first patent (1744), some say in 1730. characteristic qualities, from an artistic poi view, of its productions resemble those of Ch porcelain, but they were not developed i instances to the full extent possible; the pe tion into the glaze of the enamel colours, an warm luminous quality of the paste, are comm able features in Bow porcelain, but the fre porosity of the body admitted of the ready al tion of grease, and of accidental colouring stances, which caused unsightly disfigurem From what I have said, it will be evident the characteristic ingredient of Bow porcelai bone ash or phosphate of lime, which subseq came into general use throughout the countr

A few of the recorded recipes for the ma ture of the body of ordinary English porc during the last 40 or 50 years, will serve to the important part which phosphate of lime in this composition:—

	i.	ii.	iii.	iv.
Bone ash	47	46	46	40
China clay	34	23	23	30
China stone	—	28	31	30
Flint	—	—	—	—
Felspar	19	—	—	—
Glassy frit	—	3	—	—

Analyses of modern English porcelain, about 1840, gave:—

Silica	40
Alumina	22 to
Lime	10 to
Phosphate of lime and iron	15 to
Alkalies	2 to

Thus far, I have spoken almost exclusively productions of Chelsea and Bow; a third English factory demands some attention Worcester stands by itself in more particular one, but its survival for 130 years alone se it from all other English factories in an tional way. In order to study the producti the Worcester works intelligently, it is neces

nanges of style and taste which occurred e to time in the history of the porcelain d it is also necessary to observe the suc- anges of composition, and consequently both in body and glaze. A convenient gical arrangement of the Worcester periods .

Old.	Modern.
1751 to 1772.	IV. 1793 to 1807.
1772 to 1783.	V. 1807 to 1813.
1783 to 1793.	VI. 1813 to 1840.

n artistic point of view the works of the od greatly transcend those of the modern. d gilding, and the hard over-precise finish, arked the productions of the closing years ghteenth century and of the later time, have deprived the decoration of Worcester all its original softness, freedom, and he painters and gilders seemed to have ing to emulate the rigid exactitude of ical processes, which were coming day e into vogue. And they succeeded very pressing the human element of their and in making it gorgeous, precise, esting.

led, through the kindness of Mr. R. W. learned and talented director of the Works, to give you the recipe for the of the earliest body made at Worcester; e True Secret of Making Worcester a secret supposed to have been lost. body was a mixture of a prepared ur other ingredients.

ORCESTER BODY OF 1ST PERIOD.

....	5 parts.
....	5 ,,
ass	2 ,,
py rock	1 ,,
y rock	4½ ,,

bove-named was prepared from the gredients:—

....	40 parts.
flint	24 ,,
....	8 ,,
....	1 ,,

e second period the body contained:—

....	75 parts.
....	15 ,,
....	10 ,,

used being prepared from—

....	120 parts.
....	7 ,,
....	7 ,,
....	14 ,,
....	40 ,,

used at Worcester in the second period m—

....	38 parts.
....	27 ,,
....	11 ,,
of potash	15 ,,
of soda	9 ,,

supply of "soapy rock," that is, other hydrated magnesian silicates pentine (from Mullion, in Cornwall) one ash, which is still largely used at placed it.

er went on to describe the *peculiarities* of several specimens of old and modern Worcester porcelain, which were on the table.]

The following list of potteries where soft paste porcelain was made, is instructive in many ways, but has no pretension to completeness. The history of almost all manufactories has been a chequered one, and many have enjoyed but a very brief existence:—

1745 to 1849, Derby.	1795 to 1812, Pinxton.
1751 to ——, Worcester.	1813 to 1820, Nantgarw.
1756 to 1802, Lowestoft.	1814 to 1817, Swansea.
1772 to 1814, Caughley.	1820 to 1842, Swinton.

[The lecturer proceeded to illustrate the peculiar qualities of the porcelains produced at these factories by means of specimens on the table.]

I cannot conclude without expressing my best thanks for the loan of specimens, new and old, to Messrs. Minton, of Stoke, to Mr. R. W. Binns, of Worcester, to Messrs. Phillips, of Oxford-street, and to Mr. Litchfield, of Hanway-street.

ERRATUM IN LECTURE III.—The figure 3 has dropped, during printing, from the formula $Fe_2 O_3$, on page 107, line 3.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock:—

JANUARY 19.—"Causes of Success and Failure in Modern Gold Mining." By ALFRED G. LOCK, F.R.G.S. HYDE CLARKE, Esq., will preside.

JANUARY 26.—"Five Years' Experience of the Working of the Trade Marks' Registration Act." By EDMUND JOHNSON.

FEBRUARY 2.—"Trade Prospects." By STEPHEN BOURNE.

FEBRUARY 9.—"The Present Condition of the Art of Wood-carving in England." By J. HUNGERFORD POLLEN.

FEBRUARY 16.—"The Participation of Labour in the Profits of Enterprise." By SEDLEY TAYLOR, M.A., late Fellow of Trinity College, Cambridge.

FEBRUARY 23.—"Recent Advances in Electric Lighting." By W. H. PREECE, Pres. Soc. Tel. Eng.

MARCH 2.—"Flashing Signals for Lighthouses." By Sir WILLIAM THOMSON, LL.D., F.R.S.

MARCH 9.—"Improvements in the Treatment of Esparto for the Manufacture of Paper." By WILLIAM ARNOT, F.C.S.

MARCH 16.—"The Manufacture of Aërated Waters." By T. P. BRUCE WARREN.

MARCH 23.—"The Increasing Number of Deaths from Explosions, with an Examination of the Causes" By CORNELIUS WALFORD.

Dates not yet fixed:—

"Buying and Selling; its Nature and its Tools." By Prof. BONAMY PRICE. On this evening Lord ALFRED S. CHURCHILL will preside.

"The Discrimination and Artistic Use of Precious Stones." By Prof. A. H. CHURCH, F.C.S.

"The Compound Air Engine." By Col. F. BEAUMONT, R.E.

FOREIGN AND COLONIAL SECTION.

Tuesday evenings, at eight o'clock:—

FEBRUARY 1.—"The Industrial Products of South Africa." By the Right Honourable Sir HENRY BARTLE FRERE, Bart., G.C.B., G.C.S.I., D.C.L., LL.D., F.R.G.S., &c.

FEBRUARY 22.—"The Languages of South Africa." By ROBERT N. CUST.

MARCH 15.—"The Loo Choo Islands." By Consul JOHN A. GUBBINS.

April 5.—"Trade Relations between Great Britain and her Dependencies." By William Westgarth.

Applied Chemistry and Physics Section.

Thursday evenings, at eight o'clock:—

January 27.—"A New Mechanical Furnace, and a Continuous System of Manufacturing Sulphate of Soda." By James Mactear, F.C.S. J. C. Stevenson, M.P., will preside.

February 24.—"Deep Sea Investigation, and the Apparatus used in it." By J. G. Buchanan, F.R.S.E., F.C.S.

March 24.—"The Future Development of Electrical Appliances." By Prof. John Perry.

Indian Section.

Friday evenings, at eight o'clock:—

January 21.—"Forest Conservancy in India." By Sir Richard Temple, Bart., G.C.S.I.

February 11.—"The Gold Fields of India." By Hyde Clarke.

March 4.—"The Results of British Rule in India." By J. M. Maclean.

March 25.—"The Tenure and Cultivation of Land in India." By Sir George Campbell, K.C.S.I., M.P.

May 13.—"Burmah." By General Sir Arthur Phayre, G.C.M.G., K.C.S.I., C.B.

Cantor Lectures.

Monday evenings, at eight o'clock:—

The Second Course will be on "Watchmaking," by Edward Rigg, M.A. Three Lectures.

Syllabus of the Course.

Lecture I.—February 7.

Introduction—Units of Time—Historical Sketch—Description of usual forms of watch—Escapements—Conditions of accurate timekeeping, and arrangements necessary for their maintenance in the higher class of watch.

Lecture II.—February 14.

The ordinary watch—Degree of accuracy required in it—Systems of manufacture in this country and abroad—Description of specimens illustrative of the various stages of construction—Comparison of the several systems.

Lecture III.—February 21.

Necessity of efforts to promote the art in this country—Need of education, theoretical and practical, in horology—Literature—Great want of uniformity in gauges. screws, &c.—Exhibition of ordinary and complicated watches, and of watchmakers' tools—Conclusion.

The Lectures will be illustrated by Specimens, Models, and Diagrams. The different movements, &c., will be shown enlarged on the screen by means of the Aphengiscope and the Electric Light.

The Third Course will be on "The Scientific Principles involved in Electric Lighting," by Prof. W. G. Adams, F.R.S. Four Lectures.

March 7, 14, 21, 28.

The Fourth Course will be on "The Art of Lace-making," by Alan S. Cole. Three Lectures.

April 25; May 2, 9.

The Fifth Course will be on "Colour Blindness and its Influence upon Various Industries," by R. Brudenell Carter, F.R.C.S. Three Lectures.

May 16, 23, 30.

Admission to Meetings.

Members have the right of attendin[g the] Society's meetings and lectures. Ever[y Member] can admit *two* friends to the Ordinary and [Section] Meetings, and *one* friend to the Cantor [Lectures.] Books of tickets for the purpose have b[een issued] to the Members, but admission can also b[e obtained] on the personal introduction of a Memb[er.]

MEETINGS FOR THE ENSUING W[EEK.]

Monday, Jan. 17th...Royal Geographical, Universit[y] Burlington-gardens, W., 8½ p.m. Mr. C. [...] "The Arctic Discoveries along the Coa[st of Franz] Josef Land, by Mr. B. Leigh Smith, in 18[...]
British Architects, 9, Conduit-street, W., [...] journed Discussion on Mr. E. C. Ro[...] "Sanitary Science in its Relation to Civil A[...]
Medical, 11, Chandos-street, W., 8½ p.m.
Victoria Institute, 7, Adelphi-terrace, W.C. [...] Southall, "Pliocene Man in America," t[...] by a second Paper on the same, by Pri[...] Dawson.
London Institution, Finsbury-circus, E.C., [...] W. Huggins, "The Photographic Spectra [...]

Tuesday, Jan. 18th...Royal Institution, Albemarle[-street, W.,] 8 p.m. Prof. E. A. Schäfer, "The Blood."
Civil Engineers, 25, Great George-street, [...] S.W., 8 p.m. Messrs. T. F. Brown and G[...] "Deep Winning of Coal in South Wales."
Statistical, Somerset-house-terrace, Strand, [...] Mr. J. T. Danson, "Growth of the Huma[n ...]
Pathological, 53, Berners-street, Oxford-stree[t ...]
Zoological, 11, Hanover-square, W., 8½ p.m.

Wednesday, Jan. 19th...SOCIETY OF ARTS, [John-street,] Adelphi, W.C., 8 p.m. Mr. A. G. Lock, [...] Success and Failure in Modern Gold Minin[g ...]
Meteorological, 25, Great George-street, [...] Annual General Meeting. Report of the [...] Address by the President.
Geological, Burlington-house, W., 8 p.m. [...] M. Duncan, "The Coralliferous Series of [...] Connexion with the last Upheaval of the [...] 2. Mr. G. R. Vine, "Further Notes on [...] Diastoporidæ, Busk." 3. Mr. G. W[...] "Further Notes on the Carboniferous Fe[...]
Entomological, 11, Chandos-street, W., 7 [p.m. ...] Meeting.
Archæological Association, 32, Sackville-str[eet ...] Mr. J. Romilly Allen, "Notes on som[e ...] Remains near Feating, Forfarshire."
Institute of Bankers (at the Theatre of the [London Insti]tution, Finsbury-circus. E.C.), 6 p.m. [...] Chalmers, "The Codification of Mercant[ile ...] especial reference to the Law of Nego[tiable Instru]ments."

Thursday, Jan. 20th...Royal, Burlington-house, W[...]
Antiquaries, Burlington-house, W., 8½ p.m.
Linnean, Burlington-house, W., 8 p.m. 1. [...] J. Lowe, "Some Hybrid British Ferns." 2[...] Phillips, "A Revision of the genus *Vibris*[...]
Chemical, Burlington-house, W., 8 p.m. [...] Armstrong, "Some Hydrocarbons pres[...] Spirit." 2. Mr. E. Vogel, "Determin[...] Relative Weight of Single Molecules." [...] Downes, "The Oxidation of Organic Mat[...] 4. Prof. Liversidge, "Analysis of Queens[...]
London Institution, Finsbury-circus, E.C., [...] W. E. Ayrton, "The Production of Elect[...]
Royal Institution, Albemarle-street, W., [...] Francis Hueffer, "The Troubadours." ([...]
Royal Historical, 22, Albemarle-street, W., [...]
Numismatic, 4, St. Martin's-place, W., 7 p[.m.]
Philosophical Club, Willis's-rooms, St. J[...] 6½ p.m.
Civil and Mechanical Engineers, 7, Westmin[ster ...] S.W., 7 p.m. Mr. J. Coates, "Application [...] Machinery to Mines, Gas Works, Grain [...] &c."

Friday, Jan. 21st...SOCIETY OF ARTS, John-s[treet ...] W.C., 8 p.m. (Indian Section.) Sir Ri[chard ...] "Forest Conservancy in India."
Royal Institution, Albemarle-street, W., 8 [...] Meeting. 9 p.m., Dr. Warren De La Rue[...] mena of the Electric Discharge with 1[...] of Silver Cells."

Saturday, Jan. 22nd...Physical, Science Schools, S[...]ton, S.W., 3 p.m. Mr. R. T. Glazebrook, "[...]ment of Small Resistances," and "[...] Comparing the Capacities of Two Conden[sers ...]
Royal Botanic, Inner-circle, Regent's-park, [...]
Royal Institution, Albemarle-street, W., [...] Sidney Colvin, "The Amazons." (Lectu[re ...]

NAL OF THE SOCIETY OF ARTS.

No. 1,470. VOL. XXIX.

FRIDAY, JANUARY 21, 1881.

nications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

ADJOURNMENT OF MEETING.

onsequence of the small attendance at the ry Meeting, last Wednesday, 19th inst. ; to the inclemency of the weather), the ion on Mr. Alfred G. Lock's paper, "Causes cess and Failure in Modern Gold Mining," ljourned to Monday evening, 24th inst., at Cards of invitation issued for the meeting available for next Monday.

LABEL FOR PLANTS.

Council are prepared to award a Society's Medal, together with a prize of £5, which en placed at their disposal for the purpose r. G. F. Wilson, F.R.S., for the best label for s.

object of the offer is to obtain a label which e cheap and durable, and may show legibly ver is written or printed thereon; the label be suitable for plants in open border. considerations will principally govern the .

award will be made on the recommenda- f a committee, which will be appointed for rpose by the Council.

imen labels, bearing a number or motto, ccompanied by a sealed envelope containing me of the sender, must be sent in to the ary not later than the 1st May, 1881.

Council reserve to themselves the right of lding the Medal and Prize offered, if, in inion of the judges, none of the specimens are deserving.

(By order)

H. TRUEMAN WOOD, Secretary.

PROCEEDINGS OF THE SOCIETY.

SEVENTH ORDINARY MEETING.

Wednesday, January 19th, 1881; B. FRANCIS COBB, Treasurer of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Barker, George E., Sutherland-villa, Chiswick.
Barlow, Walter Alfred, 6, St. Paul's-churchyard, E.C.
Buchan, William Paton, 21, Renfrew-street, Glasgow.
Burt, Frederick, F.R.G.S., Woodstock, Crescent-road, Crouch-end.
Temple, Sir Richard, Bart., G.C.S.I., C.I.E., D.C.L., The Nash, near Worcester.
Tovey, Major Hamilton, R.E., Waltham Abbey, Essex.

The following candidates were balloted for, and duly elected members of the Society:—

Andrew, Capt. C. W., 286, Kennington-park-rd., S.E.
Bayliss, Samuel, 5, Victoria-street, Westminster, S.W.
Browne, Miss Annie Leigh, 58, Porchester-terrace, W.
Johore, The Maharaja of, Singapore.
Keymer, H. J. C., Marine-cottage, Gorleston, and Gorleston-docks, Great Yarmouth.
Reid, Arthur G., M.D., Thatched House Club, St. James's-street, S.W.
Rigg, Arthur, 71, Warrington-crescent, Maida-vale, W.
Taylor, George Noble, 3, Clarendon-place, Hyde-pk., W.
Wiseman, William Percival, Cumberland-house, West Pennard, Glastonbury.
Wragge, Clement Lindley, F.R.G.S., Farley, near Cheadle, Staffordshire, and Adelaide, South Australia.

The Chairman said, as there were so few present owing to the severe weather, it was proposed that the paper should now be read, and the discussion adjourned to Monday next.

The paper read was on—

CAUSES OF SUCCESS AND FAILURE IN MODERN GOLD MINING.

By Alfred G. Lock, F.R.G.S.

The working of gold mines is usually the earliest and the most rapidly remunerative enterprise developed in the countries where they exist, doubtless from the fact that their produce is unaffected by those conditions which have more or less influence upon almost every other production of nature or art, viz., cost of transport, depreciation by time, and fluctuation of market value. Gold mining is often the first incentive to the occupation of new lands, and has been the primary cause of the progress of our most important colonies.

The "Stock Exchange Year Book" for 1880, reveals the fact that £2,240,449 of English share capital was invested in so-called "gold-mining" enterprises at the end of 1879. An analysis of this sum shows it to be composed of—

£871,658	which has never paid a dividend.
362,041	which has paid none for some years past.
110,000	which is paying about 3 per cent.
896,750	which is paying 10–50 per cent.
£2,240,449	

In other words, more than half this large amount is utterly unremunerative. Probably this fact has done much towards creating the popular notion

that gold mining is a very speculative and uncertain enterprise; whereas in fact, none is safer or more highly profitable, when properly conducted. The recent favour shown by the public towards Indian and other gold mines, seems to warrant the selection of the present occasion for a consideration of some of the causes that determine the success or failure of their working. These may be divided at starting into three distinct heads:—

1. The soundness of the constitution of the undertaking.
2. The presence of gold in the property, and the existence of the ordinary facilities for mining operations.
3. The knowledge of how to extract the gold in the property, and the provision of suitable appliances for the purpose.

Given the two first essentials, the problem is to apply the third.

Before proceeding to deal with this question, it will be necessary very briefly to glance at the several conditions under which gold occurs.

Occurrence of Gold.

These are three—(1.) In the form of scattered grains and nuggets, in alluvial deposits, having been liberated by natural causes from its original matrix; (2.) In the form of grains and leaves, in mineral veins (principally quartz), still enveloped in its matrix, but not associated with any other metals, and technically known as "free" gold; (3.) In the form of grains, imbedded in and most intimately associated with (not chemically combined with) various other metallic compounds, chiefly sulphides and arsenides, and commonly known by the comprehensive term "pyrites," disseminated throughout veins of quartz or other mineral. The first class I shall pass over, as, though of equal importance with the rest, there is less difficulty and expense in treating it. Our attention will be confined to the free gold and the pyritous gold found in mineral veins.

Treatment of the Vein-stuff for Rendering Separable the Free and Pyritous Gold.

The mere mining operations entailed in obtaining the auriferous rock may be passed over without any discussion, as being thoroughly well understood and carried out. We may proceed at once to the treatment of the material when mined, in discussing which treatment I shall refer, where necessary, to those systems which ought not to be admitted, and shall explain the reasons why they are not admissible.

The first process of the treatment is the disintegration of the material, to such a degree of fineness as will enable the gold and the pyrites to be liberated from the non-auriferous portions of the mass.

Crushing and Stamping.—The disintegration of the mineral is conducted in an establishment known as the "reduction works." The ore, being reduced to a suitable size, is submitted to the pounding action of a series of "stamps."

These are heavy iron pestles, lifted to a height of some inches, and allowed to fall upon the ore intended to be crushed. They work in a "mortar" or "coffer," an iron trough, constantly supplied with ore and water, from which the crushed material escapes, as soon as it is reduced to the desired degree of fineness, through the meshes of closely-fitting screens. The mortar is generally rectangular in form, and contains a set (usually five) of stamps, constituting a "battery." The mortars should be securely fastened to a solid foundation of heavy timber, so as to prevent jarring when at work. The stamps are established in a substantial framework, and are lifted by means of revolving "cams" or "wipers." The stamps should be round, never square, and each head should rotate, making part of a revolution each time it is lifted. It was, at one time, objected that the effective capacity of round stamps was less than that of square ones; but it has been proved, by careful experiments under like conditions, that they are equal in that respect, whilst the wear and tear is lessened by the revolution. Their weight and lift, and the speed at which they are driven, vary in almost every reduction works, opinions being greatly divided on each of these points. Their proper adaptation to the ore under treatment has an important influence upon the success of the operation.

The weight of stamps ranges, in Victoria, from 224 to 1,232 lbs. per head. Although a medium weight of 560 to 672 lbs. is found in most instances to best suit the character of the ore, yet, in others, a higher figure may be necessitated. In America, the weight varies from 700 to 950 lbs.

The height of drop or fall varies from 2 to 11 inches in Victoria, and from 7 to 11 inches in America. It should not be less than 7 inches, and may be advantageously increased if the stamps are light.

The speed differs in like manner: in Victoria, it varies from 45 to 85 blows per minute (75 to 80 being generally considered best); in America, from 70 to 100.

The order in which the stamps drop varies in different mills, but the desired conditions are (1), that the work of raising the stamps shall be uniformly distributed on the cam-shaft, so that the weight lifted may be, as nearly as possible, the same at any period of the revolution; and (2), that each stamp shall fall effectively upon the material to be crushed, and maintain its proper distribution. If the stamps were allowed to rise and fall in regular succession, from one end of the battery to the other, the material would accumulate at one end, and the effective duty of all the stamps would be greatly diminished. In a five-stamp battery, a common sequence is (1) the middle stamp, (2) the end one on the right, (3) the second on the left, (4) the second on the right, (5) the end one on the left. Another, which makes a backward and forward wave, and thus keeps the mortar very evenly filled, is (1) the middle stamp, (2) the second on the right, (3) the end one on the right, (4) the second on the left, (5) the end one on the left. In other mills, the end stamps are dropped first, thus, (1) the end stamp on the left, (2) the end one on the right, (3) the second on the left, (4) the second on the right, (5) the middle one. It is thought that the middle stamp dropping first secures the greatest discharge, and that the end stamps dropping first ensures the greatest quantity being stamped.

The action of the stamps in the presence of water is to reduce the material to such a degree of fineness as will enable it to flow off with the water, which flashes up at each blow of the stamps,

through the screens placed at the exit from the mortar. The prompt escape of this fine material is of great importance; consequently, the arrangement should admit of both a back and front discharge. This fact has been overlooked even in some of the batteries most recently despatched to the Indian gold-fields, which were provided with one escape only, and had their effectiveness thus reduced by one-half.

The "gauge," or number of perforations of the gratings, or screens, varies in different works: in Victoria, from 60 up to 800 holes per square inch; in America, from 900 to 10,000 holes per square inch. As this determines the degree of disintegration to which the material is subjected, it should be regulated by the character of the gold contained in the material, and should always be sufficiently fine to ensure the liberation of the auriferous particles. Care must be taken, on the other hand, that it is not so fine as to cause a difficulty in arresting the particles. For reasons to be explained presently, I am of opinion that 400 holes per square inch should not be exceeded.

In order to save the mortars from wear and tear, iron dies, or false bottoms, are placed on them, to receive the blows from the stamps. In America, they are generally of cast iron, and rest directly on the mortar. In Victoria, the much better plan is adopted of allowing the dies to rest upon a layer, at least three inches thick, of finely broken quartz. By having dies of the same size as the stamp-heads placed on this layer of quartz gravel, an opportunity is provided for the liberated gold particles to get into the gravel, out of reach of the stamps, and thence they are easily recovered.

The character of the blow demands attention. The hardness of the mineral containing gold is always so much greater than that of gold itself, or even of auriferous pyrites, that the same amount of stamping on the three substances will render the two latter much finer than the former. But it is of the most importance to prevent the gold from being smashed too fine, or beaten flat, for in those conditions it is very liable to be lost. The tendency of slow heavy blows is to flatten the gold particles, while that of smart light blows is to effect disintegration without materially altering the shape of the particles.

The effectiveness of the stamps is largely dependent upon the regularity with which they are supplied with ore. This is frequently done by hand labour, which has many advocates; but labour is saved, wear and tear are lessened, and usually greater regularity is ensured, by using a self-feeding apparatus. This consists of a hopper, filled with ore, from which an inclined trough leads to the battery; this trough, agitated by the stamps, discharges its contents gradually into the battery.

The trough supplying water to the battery is generally placed under the self-feeding apparatus. The quantity used is in proportion to the character of the ore, and the degree of fineness to which it is crushed. In Victoria, it varies from 30 to 1,200 gallons per stamp-head per hour, though 300 to 500 may be reckoned as satisfying all requirements. In America, on the other hand, about 93 gallons per stamp-head per hour is generally thought sufficient.

It is evident that the weight and speed of the stamps, and the height of their lift, united to the number of holes per square inch in the screens, chiefly determine the "duty" of the stamps, or the quantity of ore crushed per 24 hours. Accordingly, in Victoria, it varies from 1 ton to 3 ton 13 cwt.: the Port Philip Company's 6-cwt. stamps, giving 75 blows per minute, and requiring 1 h.p. per head, crush an average of 2 tons 4 cwt. each per 24 hours; and their 8-cwt. stamps, making 75 blows, and taking 1¼ h.p., average over 3 tons in actual practice. In America, the quantity varies from 1 ton to (in some few instances) as high as 3 tons per 24 hours.

I would here direct attention to a class of stamps recently brought into notice, which, though requiring certain modifications to fit them for gold ore crushing, yet are decidedly a step in the right direction—I refer to W. Rasche's, of Melbourne, "direct acting" battery, Husband's and Sholl's Pneumatic stamps, and Patterson's "Elephant" stamps. They are all based upon one principle: the battery consists of two stamps only, driven at a great speed (150 to 200 blows per minute), and weighing only 2 to 4 cwt. each, their main differences lying in the means adopted for securing the speed. The perfection of stamping, so far as quantity is concerned, would be gained by allowing each stamp in a battery to work independently, and to surround it on all sides by screens. One reason why some of the stamps in Victoria and America crush so much more than others is, that they have screens both at the back and at the front of the battery.

An excellent little stamp for prospecting purposes has been quite lately invented by Dunham. It can be driven by mule or hand power, and is exceedingly portable; the stamp is surrounded by screens, and, consequently, permits the maximum of duty to be reached.

Appliances for Arresting the Gold (both Free and Pyritous) Rendered Separable by the Stamping Operation.

Having treated of the means by which the auriferous material is disintegrated, it will next be necessary to describe the appliances used for separating the free gold and pyrites from the other finely divided matters, in whose company they leave the battery. This separation is effected by a combination of two distinct processes:—(1.) The first consists in directing the components of the mass through, over, or among a body of mercury, which metal possesses the peculiar property of absorbing the particles of free gold. This absorption is known as "amalgamation," and as it constitutes the most certain and satisfactory method of collecting the minute particles of gold from which the mercury can be separated afterwards without loss, the object of all the processes employed is, or should be, to bring the gold into a fit condition to be amalgamated, when it is not already in that condition. (2.) The second process is the provision of a number of checks or obstructions to the onward flow of the matters, with the object of presenting abundant opportunities for the greater specific gravity of the most valuable portions of the mass to exert itself, causing them to be arrested, while the worthless matters and a portion of the pyrites flow away to undergo further treatment.

Mercury Methods.—There are three essentially different methods of applying mercury for the re

covery of the free gold at this stage of the treatment. That most widely used originated in America; it consists in placing a quantity of mercury in the coffers of the stamps, so that it may be pounded up with the material, supplementing this by a considerable area of so-called "amalgamated copper plates," for catching both the free gold which has escaped the mercury and also that which has formed an amalgam with it. The mercury introduced into the batteries is added in small quantities from time to time, according to the richness of the material and the rapidity with which amalgam is formed. The amalgamated plates are formed by a somewhat delicate and tedious process, of covering one side of pieces of sheet copper (more recently electro-silvered) with a coating of mercury. That portion of the interior of the batteries which is not occupied by the screens, is lined with these plates, fixed in an inclined position, and so as to be readily removed and replaced. By the churning that takes place in the battery, particles of gold, mercury, and amalgam are splashed up on these plates, and attach themselves to the surfaces, which are periodically cleaned. Outside the batteries are placed tables, covered with similar amalgamated plates, adjusted at such an inclination as will permit a ready flow of the materials over the surface, without being so rapid as to wash away the gold and amalgam, or prevent their adhesion to the plate. The inclination necessarily differs according to the supply of water, and other conditions. The gold and amalgam collected on these plates are removed in the same way as from the others. The matters not retained by the plates escape with the "tailings," the treatment of which will receive special attention presently.

I venture to assert that this system of putting mercury into the stamp coffers, and using amalgamated plates, is radically wrong. First, as to the former. Even supposing the ore under treatment to contain no pyrites whatever, a condition which is probably never met with in practice, the stamping up of the mercury is alone a cause of great loss of that valuable commodity. But where pyrites is present, there is incurred the additional evil that the pyrites grains form a coating over the globules of mercury and amalgam, or cause "flouring," as it is technically called, thereby producing a triple loss — a loss of gold which has not been amalgamated, of gold which has, and of mercury — for no effective method has yet been found for catching this "floured" stuff. As to the amalgamated plates, it is an incontestible fact that they do not catch such a proportion of the gold as to render them of any real service. Probably the highest portion of the gold caught by them never exceeds 55 per cent.; and when other appliances are not used in conjunction, the loss of gold may amount to half of the total contained in the ore. It may be safely said that their use has been abandoned on all properties where any pretence is made of saving above 80 per cent. of the ascertained contents of the ore.

The second means of exposing mercury to the crushed material may be divided into two heads—mercury "ripples," or "riffles," and mercury "troughs." Mercury ripples consist of grooves cut across the "ripple-board tables," inclined planes of wood, varying in length, and placed in the route of the materials leaving the stamps. These grooves are cut about 2½ feet apart, and are 1 inch deep at the lower side, diminishing till they are flush with the surface of the bath at the upper edge, and about 3 inches wide. While at work, they are kept nearly full of mercury. They are generally used in combination with blanket-tables, and are most favoured in Australia. The mercury trough may also be considered as essentially Australian. A very effective arrangement of blanket-tables and mercury troughs, adopted by the largest Victorian companies, is as follows:—The material leaving the stamps is led into a trough, having a perforated plate at the bottom to keep back any coarse stuff, by which it is easily distributed; thence it passes into three connected troughs, containing mercury, dropping from the first into the second, and from the second into the third. Each of these troughs is fitted with a splash-board, which, reaching down to within a certain distance of the bottom, compels the falling matter to penetrate the mercury more or less, before escaping over the lip of the trough. Each trough has a tap-hole on one side, by means of which the amalgam may be drawn off. The whole of the contrivance is under lock and key, which prevents stealing. At the end of the blanket-table, another similar trough is placed, through which the material passes before entering the waste-trough. The amalgam formed in all these troughs is periodically removed.

The third plan of amalgamating at this stage is by grinding the crushed material with mercury in little mills, as in Hungary. The same objections apply to this, as to the system of introducing mercury into the material under the stamps.

Blanket-tables.—The representative of the second class of appliance is the "blanket-table." This consists of a wooden floor, stretching across in front of the batteries, with a varying length, and laid at a varying pitch or incline. It is fixed securely, and in such a manner as to enable the pitch to be altered, always observing the utmost regularity in its arrangement, and ensuring precisely the same degree of pitch throughout the entire length. The surface of the table is made perfectly smooth and true. By means of narrow strips of wood fastened to the floor, it is subdivided into "strakes," one for each stamp in the battery. Sometimes the table is broken transversely, into sections of three feet or so, the upper edge of each section being about two inches below the over-lapping edge of the next above. The surface is covered throughout with closely woven baize or blanket, laid on with extreme care, so as to lie flat, and cling to the boards.

The mixture of water and disintegrated matters leaving the battery, passes over the surface of the blanketing in a thin stream. The specific gravity of the gold and pyrites causes them to descend to the lowest stratum of this stream, by which they are brought into contact with the fibres of the blanketing, and are induced to settle among them. From these, they are subsequently dislodged by washing in clean water.

Many conditions govern the success or failure of this apparatus. (1.) When the gold is stamped to an excessive degree of fineness, or is flattened into tiny thin plates, it becomes what is known as "float" gold, *i.e.*, owing to the minuteness of the

es, or their flattened shape, they lose the)f their great specific gravity, and actually way. Hence the fallacy of too fine stamping. ie supply of water, received through the ·, must be exactly adapted to the nature of iterial under treatment; if too little, the il will be unevenly distributed, and will e blankets; if too great, it will wash away id. (3.) The excessive inclination of the is often a source of great loss; it should y ever be greater than one in 14-16. he length of the table is of importance in re- ; the inevitable loss to a minimum; for, h by far the largest proportion of the valu- atters is deposited on the first few feet of rakes, yet, however far the latter may be ned, they will always catch some particles. ictice, it would be inconvenient to much 30 feet, but 20 feet should be regarded as a im figure. (5.) The interstices of the ting would, in course of time, become l with heavy matters, and would then cease a receptacle. The renewing and washing therefore, be performed at sufficiently short als. The frequency with which this is ed will much depend upon the character of iterial, being increased when it is "slimy," hen much pyrites is present. The first series inkets may need changing every hour, or oftener, the second every two hours or so, he remainder every six to twelve hours. gold is lost through slovenliness in this de- ient. (6.) Sufficient care is not generally ised in the selection of the fibrous material for covering the strakes; and experi- s with various kinds of hair and wool, and different classes of fabric, may be expected to r considerable light upon the subject.

TREATMENT OF THE BLANKET-SAND.

rrel Amalgamation.—The material gathered the blanket-strakes, consisting of grains of gold, globules of mercury, and particles of lgam, which have been splashed or washed i the troughs, ripples, or plates, with a large itity of pyrites and some worthless material, collectively termed "blanket-sand," is usually ed with mercury in a revolving barrel, the ss being known as "barrel amalgamation." i the proportion of free gold is considerable, the operation is properly conducted, it gives satisfactory results. The barrels are of wood m, and are constructed to revolve on a pivot at end. The charge is 8 to 10 cwt. of the damp :et-sand, and 200 to 300 lbs. of mercury; the l is then set to revolve for about eight hours, peed of 14 to 16 revolutions a minute. After it is filled up with hot water, and set to ve again for another four hours, at a rate of 6 revolutions a minute. This concludes the ition, and the charge may be drawn off. The mercury and most of the amalgam are with- n first. The remainder of the contents is to a shaking-table, or some similar contri- s for effecting the separation of the amalgam, es, and refuse. The two latter are treated ame as the "tailings." Stones and pieces of are sometimes put into the barrel, with the ieous idea that they grind the sand finer, and he amalgamation. This should on no account be done, as, with pyrites present, the grinding will inevitably cause sickening or flouring of the mercury. When very little free gold is present, it is a better plan to treat the blanket-sand in the same manner as the concentrated tailings, to be described hereafter.

TREATMENT OF THE "TAILINGS."

All the stamped material remaining beyond the portions which are caught by the blankets, plates, ripples, and troughs, is collectively known as "tailings." It consists principally of fine earthy matters, but contains also more or less of gold, amalgam, mercury, and pyrites, chiefly the last. In some instances, especially when the ore contains a large proportion of pyrites, the tailings have a very high value; in all cases, the recovery of the gold contained in them demands the earnest attention of the miner who desires to achieve success. Unfortunately their treatment is full of difficulty, and hence the only too frequent disposition to neglect them totally or partially. It is only where the poverty of the ores renders it compulsory to extract all the precious metal they contain, in order to give a remunerative yield, that any really effective and economical plans have been devised for the purpose. Where the ores are sufficiently rich to pay a good profit from the more easily extracted portion, little attention has been given to this question. But the knowledge gained in one region should be applied in all, and there is no excuse for throwing away a quantity of gold because the mine happens to pay well without it. Such an undertaking must be undoubtedly catalogued among the failures, whatever profits it may return.

Settling-boxes.—The sands, pyrites, slime and water, which have escaped from the blankets and the last mercury-trough into the waste-trough, pass direct to "settling-boxes," where the current is checked, and the heavier material settles. These boxes are generally cleaned out every few hours, and the material is passed on at once to some machine for concentration. The fallacy of this step will be evident, when we consider that all methods for the mechanical concentration of ores by means of water, based upon the fact that the ore is specifically heavier than the refuse, can only fully succeed when that superior weight of the ore is most thoroughly availed of. I have previously alluded to the fact that the relatively greater specific gravity of the particles may lose its effect in the presence of material of disproportionate size and shape. The latter feature cannot be controlled, as it is determined during the process of crushing; but for the classification of the grains according to size, at least within certain limits, a number of contrivances have been invented, and are in every-day use in Europe, for the concentration of such heavy ores as galena, tin ore, &c. Their value for application to the treatment of auriferous pyrites is intensified by the fact that the gravity of the latter, as compared with that of quartz, presents far less contrast than does that of lead or tin ore to its gangue; besides, the pyrites is so much softer and more brittle than the quartz, that it is crushed relatively much finer. For these reasons, the "sizing" of the tailings, before any attempt is made to concentrate

their valuable portion, must evidently be of considerable advantage.

Sizing.—Of the contrivances for classifying according to size, the most exact are probably inclined, rotating, sieve drums. In these, the material is introduced at the higher end, and passes through finer and coarser sieves in succession. But the objection to their use is that they require a considerable amount of attention, so that they are not suited for a country where labour is dear; nor have they the capacity for treating the large bulk of material which accumulates at many of the great gold mines.

The foremost authorities in Australia recommend separation into three sizes, each to be treated distinctly afterwards. Some speak highly of German "pyramidal boxes," and "triangular double troughs." The "pyramidal box" consists of a series of V-shaped troughs, increasing in size towards the outlet, over which a stream of water and material is constantly passed. The heaviest particles fall in the first box, the next heaviest in the second, and so on. The "triangular double trough" has the same object in view. It consists of two or more consecutive V-shaped troughs, into which are fitted triangular stops, which compel the stream of water and material entering at one end to perform a series of descents and ascents. The heavy matters are deposited at the bottom of the trough, while the lighter matters are carried up by the force of the water.

Concentration or Separation.—Having classified the material according to size, the next step is to submit each separate size to a process of concentration, with the object of eliminating the valuable portion. For this purpose, many machines are in use. A description of them all would occupy too great space here, but they will receive attention in my forthcoming book. Probably the most perfect, and one which is said by some in Australia to save 95 per cent. of the pyrites present, is Borlase's "buddle," fitted with Munday's "scrapers." It consists of a circular wooden trough, 18 to 24 ft. in diameter and about 1 ft. 6 in. deep. The crushed material, with additional water, is conveyed into a box in the centre of the trough, from which it escapes by revolving pipes, and comes into contact with the sides of the trough. In flowing over the sloping floor of the buddle, the pyrites, from their greater specific gravity, become separated, and are deposited upon the floor, whilst the lighter refuse substances are carried away through a discharge pipe. Several rims or stops are placed on the floor to facilitate the collection of the pyrites, which, as collected, is constantly levelled and distributed by the scrapers, which are set at a suitable angle, and revolve with the shaft. When they descend too deep, owing to the quantity of pyrites collected, they are raised by screws. Attention to the quantity of water and crushed material flowing into the buddle, and the speed at which it revolves, are essential to obtain the best results. The various so-called separators or concentrators, of which I have described one as a type, effect the separation of the pyrites from the gangue or refuse, or, in other words, concentrate the pyrites by elimination of the refuse matters.

TREATMENT OF THE PYRITES.

Having secured the pyrites in a fairly clean condition, the next step is to extract the gold c tained in them. This is often conducted as a sepa industry, especially where the proportion pyrites yielded by the ores is too small to permi each mine maintaining an establishment for purpose, and where the necessary facilities—ch fuel and skilled labour—do not exist.

Under this section, will be included the treatn of all compounds of the baser metals, in wl association gold is found. The treatment of ores will have been pretty much the same u this point, whether the gold were in a free st or associated with various metallic sulphi arsenides, &c. Of course, should the ore con no fine gold whatever, the mercury methods mi be dispensed with; but the blanket-tables, siz and concentrators will need more than u attention.

The gold found in these ores is probably alw in a native state, that is to say, it is not in chem combination, though the mechanical associ may be exceedingly close. In some instance deed, the grains of gold are covered by a m scopically fine film of sulphide, sufficient to pr actual contact between the gold and mercury. fact, combined with what has been previousl about the flouring of mercury placed in the st boxes, by reason of the sulphides met with, conclusively to the error of attempting to amalgamation of the gold in such ores by me grinding with mercury, for not only will m the gold be lost, but much mercury will be fl and also lost.

It may be taken as an established fact tha first step necessary to the recovery of the gold such compounds is the oxidation of the sulph arsenides, or other compounds which hol prisoner. The least experienced gold-miner kn that pyrites which has been exposed in heaps years to the weather, yields a far greater per-ce age of gold than it did when first placed in heap, the gold having been liberated by the o dation caused by the exposure. But this necessarily a very slow process, and not quit perfect one. A more rapid and effectual w of securing the same result is by roast the material in a reverberatory furnace, so to volatilize the sulphur, &c. These furn are constructed on many plans. The one adop by some of the largest and most advanced w in Australia is the inclined reverberatory fur of Latta and Thompson. It only requires one per shift to work it. It consists of a fire-box at lowest end, from which the heat passes over pyrites on the hearth. It has doors on each by means of which the pyrites are gradu drawn down over the hearth, beginning with hopper which supplies the pyrites, and whic situated at the higher end of it, until they r the bottom, where they fall into a channel, wh they are drawn into a pit. The labour ma reduced by making the furnace in three sectio right angles to each other, so as to facilitate operation of working the charge through. roasting must be continued until all the sul and arsenic are driven off, and the pyrites bec "sweet;" but the heat must not be carried high, nor is it necessary to convert all the into sesquioxide. The time occupied in the o tion is 12 to 18 hours, but efficiency must n

to time, for partially decomposed pyrites
re "flouring" of the mercury, and
ss of gold and amalgam in the succeed-
ion, than undecomposed pyrites. The
is judged by the material emitting
nor fumes, by giving off no sparks
y its turning red when cold, and by
run easily when stirred. About
of pyrites can be treated in
a furnace. The consumption of
depend upon the regular feeding of
attention must also be paid to the
furnace, as it is essential that a
of air should pass over the surface
to ensure their thorough oxidation,
must be adopted to effect this.
vided as to whether the presence of
ntage of sand with the pyrites is
beneficial; on the one side, it is
hat the sand tends to check the
or "caking" of the particles, which,
egun, makes it very difficult, if not
o roast properly; on the other hand,
ded that the sand cuts up the mercury,
a great loss in the subsequent process
mation, especially if a Chilian mill is
xing charcoal with the pyrites in roast-
otes their decomposition by the combi-
the carbon with the sulphur, but a good
properly attended requires no such aid,
n lead or antimony are present in the
the carbon acts injuriously (by reducing
ls).

er furnace which is highly spoken of is
lving furnace. It consists of a fire-box,
the heat and products of combustion tra-
iron tube, lined with fire-bricks, supported
lination which varies with the character of
It rests upon friction wheels, and is rotated
ng at the lower end; it passes into the
aber, and is so arranged as to deliver the
ing through it by an opening into the
At the upper end, it communicates
s or condensing chambers. The ore, dried
ates covering the condensing chambers,
o a hopper by a boy, who also attends to
The tube makes three to eight revolutions
; in its progress, it raises the ore by four
r shelves parallel with its axis, whence
lls off in thin streams through the heated
he tube. The sulphur and arsenic thus
l burn so freely that much of the former,
of the latter, will have escaped before the
ived half-way along the tube, and the
d by this combustion is available for
e upper portion of the tube. The advan-
is furnace are—saving of labour for dis-
he pyrites, and the completeness with
listribution is effected.

ation.—The object of simple roasting is
gold from its companionship, and render
le of amalgamation. In order to effect
the roasted pyrites are ground with
Chilian mills, in Arrastras, or in
or Hepburn and Peterson's pans, &c.
in all is to break up the mercury, and
orough penetration of the sand operated
it may take up all the gold brought
t with it. The successful conduct of
is by no means easy, for the very means
adopted to secure effective amalgamation give rise to a flouring of the mercury, brought about by mechanical action, and causing a great loss of mercury during the subsequent operation of flushing off. Several specifics have been proposed for lessening this loss. "Sodium amalgam" keeps the surface of the mercury bright and quick, owing to the gradual oxidation of the sodium, and is by many considered to prevent flouring, and to assist in collecting the mercury when floured; by others, it is thought to gather base metals, and to cause a loss of mercury. It is probable that more watchfulness and attention to its peculiar properties would make it more generally successful. Solution of soda is useful for freeing the gold particles from grease; the same is more or less true of solution of potash and of lime. Potassium cyanide prevents flouring, and keeps the mercury bright. Of the acids, sulphuric acid acts better than either nitric or hydrochloric.

The matters taken from the amalgamator, of whatever kind, are next passed through a concentrator, or, better, through two in succession, and then through a mercury trough, the tail-sand being run through buddles. The proportion of the gold saved from the pyrites by the proper use of these contrivances has been as high as 95 to 98½ per cent.

Pyrites may consist of the following distinct minerals:—

	Specific gravity.
1. Iron pyrites (mundic)	4·8 — 5·2
2. Magnetic pyrites (pyrrhotine)	4·4 — 4·7
3. Arsenical pyrites (mispickel)	6·0 — 6·4
4. Copper pyrites (chalcopyrite)	4·1 — 4·3
5. Sulphide of antimony (stibnite)	4·5 — 4·6
6. Sulphide of lead (galena)	7·2 — 7·7
7. Sulphide of zinc (blende)	3·9 — 4·2

Other rarer compounds are also sometimes found, but only in such small quantities as not to interfere with any process adopted, and they will not be considered in this paper.

The most common form is a mixture of iron, magnetic, arsenical, and copper pyrites, in which any one of these may largely predominate, or be entirely absent. It is usually found that the gold exists in one or two only of the components of the mass, and not in the others. Where the gold is absent from the magnetic and copper pyrites, and present in the iron and arsenical pyrites, these may often be separated by mechanical dressing, based upon the difference in specific gravity. Where this is impossible, and the copper pyrites are sufficiently abundant and valuable to treat, Mr. Cosmo Newbery—who has a great reputation in Victoria—recommends the wet method of copper extraction, leaving the gold to be obtained by the ordinary amalgamation process, instead of smelting.

But it is only within the last few years that any process has been found for extracting the gold from ores containing sulphide of antimony, and many highly auriferous mines in Victoria have been stopped for want of such. In 1873, Messrs. Cosmo Newbery, Ulrich, and Brown, treated antimonial ores by fusing the sulphide with a proportion of metallic antimony, which, having a great affinity for gold, takes it up, and, on cooling, may be easily separated from the sulphide. The antimony is used until it has become rich in gold, when the two metals are separated by the oxidation of

the antimony. But this process is suitable only for ores rich in antimony. Mr. Cosmo Newbery, after long experimenting, has succeeded in discovering a process by which both the gold and the antimony in these poor ores can be saved. His method is to put the ore, as mined, into a close furnace, with some salt or other chloride, and heat it to dull redness; steam is then injected until the whole of the antimony is got rid of. The quartz or gangue is rendered extremely friable, the steam penetrating all parts of even the largest lumps that can be conveniently handled in charging the furnace. The chloride of antimony formed comes into contact with air on leaving the mass of ore, and is converted into oxide, the sulphuretted hydrogen being burnt at the same time; the oxide of antimony is collected in suitable condensers. When the charge is removed from the furnace, it is crushed, and the gold may be saved by amalgamation. The treatment of antimonial sands requires certain modifications. The steam is not easily introduced into a reverberatory furnace without admitting an excess of air, but a close furnace with automatic rakes may be used. The rakes, being perforated, and attached to the steam pipe, are used to distribute the steam in jets through the mass of sand.

Mr. Cosmo Newbery has gone yet further, and has devised in the laboratory a simple and inexpensive method for condensing the solidifiable portions of the fumes. It consists of a small flue, with an artificial draught, produced by a blower. The flue is contracted at intervals to a nozzle, which directs the fumes with force against a fixed plate. It is found that the solid particles adhere to this plate, forming a dense cone of such solidity that the strongest current of air fails to dislodge them.

From the practical results obtained in the treatment of the St. Arnaud (Victoria) ores, which contain, relatively to the gold, large quantities of lead, it would seem that by careful washing after amalgamation in pans, the loss to be feared from its contact with the mercury, may be so reduced as to be scarcely noticeable.

Zinc at a dull red heat alloys with gold, yet the alloy is easily amalgamated by mercury; it therefore requires no special notice.

There remains to consider two processes for the treatment of auriferous pyrites, viz.: Plattner's and Claudet's.

The former was proposed by Prof. Plattner more than 30 years ago, and has been used in Germany and America for many years; in some instances, successfully, in others, not. In Silesia (Germany), ores containing about 9 dwt. of gold per ton have been profitably treated by it; in California, also, it is considerably used. It consists in acting upon the pyrites—after roasting—by chlorine gas, obtained by the reaction of sulphuric acid with peroxide of manganese and salt. The gas forms a chloride of gold, which is dissolved out and precipitated, in the metallic state, by sulphate of iron, or as a sulphide by sulphuretted hydrogen. In theory, it is a simple process, and requires only a few hands; but in practice, there are several drawbacks. Pyrites, roasted and pulverised, fit for amalgamation, would not necessarily be fit for chlorination. Metallic iron must not be present, or it will precipitate the chloride of gold, and it is essential that all the particles of gold shal[l be] as nearly as possible of the same size, as any la[rge] pieces will prolong the operation, and so ca[use] waste of time and loss. In many countries, it c[an]not be used, as the chlorine-producing mater[ials] cannot be obtained sufficiently cheap.

With regard to Claudet's process, Mr. J. Ar[thur] Phillips, the well-known metallurgist, who [was] associated with M. Claudet in carrying out [the] invention, assures me that it is quite unfi[t] to deal with ordinary auriferous pyrites, it b[eing] essentially a copper process, in which the go[ld is] obtained as a bye-product at very small [ex]pense.

Oxidation.—The last point to which I shall [refer] is one which bids fair, if successful, to revolut[ionise] the entire present treatment of pyritous ores[. It] is no less than oxidising them before crus[hing,] thus saving the losses and expenses of conc[en]tration, roasting, and subsequent amalgam[ation.] This, Mr. Cosmo Newbery has successfully a[ccom]plished in the laboratory, by a similar proc[ess] that I have just described as being used fo[r the] treatment of antimonial ores, viz., roasting [in a] close furnace with the introduction of steam. [It] remains to be seen whether the cost for fuel, lab[our,] &c., will render the operation more profitable t[han] the means now adopted.

Resume.

In this brief description of the processes follo[wed] in extracting gold from its natural combinatio[ns,] I have endeavoured to introduce allusions to the most important of the improper methods wh[ich] have crept into use.

A cause of failure not yet noticed is the pract[ice] of burning the vein-stuff before crushing, w[ith] the object of lessening the wear and tear of machinery, and increasing its effectiveness, [by] rendering the quartz very friable. If pyrites w[ere] entirely absent from the ore, the process might [be] valuable; but this is rarely or never the case. [By] simply roasting such large fragments of mine[ral] it is impossible to oxidise all the sulphur pre[sent] in the pyrites. The result with common i[ron] pyrites is that a lower sulphide is formed, wh[ich] melts, and encloses fine particles of gold i[n a] ferruginous glaze; while with arsenical pyr[ites] the arsenic set free in vapour may actually form [an] alloy with the gold. In either case, the gol[d is] lost.

In conclusion, it may be interesting to illust[rate] the consequences of using suitable and unsuit[able] appliances, by a few examples of failure [and] success, quoted from official documents.

First, as to the failures. According to Mr. [R.] W. Raymond, there is no subject of "more [im]portance to the mining interest of California t[han] the economical treatment of gold-bearing ores, [and] it is a fact worthy of consideration that, afte[r] years' experience in the business of quartz-min[ing,] it is conceded that, with a few exceptions, f[rom] one-third to one-fourth of the assay value of ores now being worked, amounting to sev[eral] millions of dollars annually, passes off in slimes, and is irretrievably lost."

In the case of an Australian mine, which [was] abandoned by the owners because they ha[d no] knowledge how to extract the gold from the py[rites]

lowed gold varying from 19 dwt. 14 gr. 5 dwt. 3 gr. a ton, besides silver, the total ng £4 3s. 6d. and £6 4s. 6d. a ton respec- nd a sample of what was considered poor ave 9 dwt. 19 gr. of gold and over 25 ozs. the total value being £7 7s. 2d. a ton. A f other samples of tailings, mostly non- collected by the same official, gave the proportions of gold per ton:—9 dwt. 2 dwt. 9 grs., 13 dwt. 17 grs., 16 dwt. r dwt. 15 grs., 1 oz. 0 dwt. 21 grs., 1 oz. . grs., 1 oz. 6 dwt. 18 gr., 1 oz., 15 dwt. n New Zealand, too, no mining company able to pay a dividend from ore having 10 dwt. of gold per ton, a fact largely positive loss of gold, which, with proper es, might have been prevented." The list e extended indefinitely, but will suffice as ration. It shows the black side of the , and would represent gold-mining as a ly undesirable and unremunerative under- ; yet every one of these failures may be directly to a specific fault in the appliances

s refreshing to turn to the other side, and see has been effected by proper plans of treat- And here I shall refer only to examples the amount of gold obtained was less the smallest amount thrown away in the us case, which you will remember was 9 gr. The first and most prominent example well-known Port Philip Co., of Victoria, to managing director, Mr. Rivett Bland, the of gold-mining is much indebted. This ny has to raise its ore from a depth of 700 to t. During the past 10 years, it has treated l tons, the average yield of which was 13 gr., the extremes being 3 dwt. 23½ gr. in nd 7 dwt. 21 gr. in 1878. The same com- has treated 3,593 tons of pyrites, yielding an ge of 4 oz. 3 dwt. 17 gr. of gold, when con- ted. The average total cost of treat- has been £3 13s. 7d. a ton; the average , £13 5s. Another Australian company, part of its ore from surface workings, profitably crushed 283,550 tons, with an ge yield of 2 dwt. 22 gr. Another treated tons in seven months, with a return of . 10¼ gr., and paid £2,101 10s. profit. er realises a large profit from a yield of l dwt. 14 gr. per ton of ore crushed. But st remarkable of all is the Imperial Com- at Ballarat, which has treated 2,100 tons of , affording only 21·99 gr. of gold per ton, fair margin of profit on the operation; in words, it has made money out of material is only one-tenth part as rich as the non- s material which its neighbours are throw- ay.

urse, some allowance must be made for the er of the ore in different cases, and the conditions surrounding the undertaking; not think any doubt can now remain upon nds that if the knowledge already acquired subject of treating gold-bearing ores were ly and appropriately applied in all cases, uld soon see a satisfactory return for m of one million some odd thousand to which I referred at the beginning of r.

DISCUSSION.

The Chairman said as it was possible there might be some gentlemen present who would not be able to attend on Monday, he should be happy to hear any remarks any one might wish to make.

Mr. J. Valentine Smedley said he should like to express his appreciation of the paper and his thanks to Mr. Lock. He was not a mining engineer, nor qualified to give anything like a technical opinion upon the paper, but as a private individual he was very deeply interested in mining, in spite of himself. He had been connected with mining of various kinds during the last 20 years, as proprietor, as a shareholder in several mines, as director of several collieries, and as chairman, and, from having lost a good deal of money in mining he had endeavoured to abandon it, but in spite of his efforts, somehow or other, mining had stuck to him. At this particular period, when gold mining in India was so prominently before the investing public, Mr. Lock's paper was eminently opportune. The unfortunate experience he (Mr. Smedley) had had in gold mining led him to the conclusion that, whereas, as Mr. Lock had shown, they might be told what methods to avoid, and, on the other hand, what to adopt, he would go farther, and say that even in the case of proper methods and appliances, unless they were properly administered by the local managers or superintendents in charge, the great advantage of the improved methods was lost. It seemed to him that in almost every case the causes of failure had been nothing more nor less than local mismanagement of mines. He had not the number of dividend and non-dividend mines at his finger-ends, but he believed there were more of the latter than of the former; and he was one of those who thought that this was not owing to any want of precious metal in the mines, but because the mines were badly administered. Even in cases where proper treatment, such as suggested by Mr. Lock, had been present, the cause of failure was owing to those methods not being properly administered. He thought the time had come when a revolution must take place in the system of the management of mines.

Mr. Hepple Hall said he had not the same interest in gold mining as the previous speaker, but he had been a great deal in gold mining countries, and had seen a great deal of the various methods adopted. He came there expecting a great treat, and he had not been disappointed, but still he regretted that the paper had not a rather broader scope, for it seemed devoted principally to Australia, with some references to California. He had been in British Columbia and in Nova Scotia, where there was a great deal of gold mining, but this had not been touched upon in the paper. He would withhold any general remarks until the next meeting.

Mr. Fretwell asked if Mr. Lock had had any experience of gold mining in Hungary, especially in Transylvania, and if he could explain why these mines had not been profitable to the Government, who worked them.

The Chairman said Mr. Lock had had considerable experience of Hungarian gold mining, and he would, no doubt, deal with it fully in the discussion. He understood the object of the paper to be on the operations of gold mining, and how to obtain the last grain of gold from the quartz or matrix in which it was contained, but he did not understand that Mr. Lock confined himself to Australia or California. He took those countries as prominent instances of the treatment of gold by crushing, as distinguished from alluvial washing, or anything of that sort. As to the question of the management of gold mines, he hardly thought they could call on Mr. Lock to discriminate between well and ill-managed mines. He simply dealt with the method of treating the ores, with a view to obtaining the best results from them.

Mr. Morgan said he was interested in silver mining and silver extraction, and he should like to ask if Mr. Lock had turned his attention to the question of lixiviation. In the concern in America in which he was interested, the rebellious ores were absolutely useless up to a certain time, but by roasting and then treating in a wet way with hypo-sulphite of soda and hypo-sulphite of lime, the mines were now returning very large profits.

Mr. Lock said his object was to get the whole subject of gold mining thoroughly considered, and to get everybody to come forward who had something to say upon it. There was a vast outlet for capital in this direction if it were thoroughly understood, but, at the same time, opportunities of learning gold mining in England were wanting, so that the thing could not be properly worked. One gentleman had just mentioned one process, and if the whole subject were gone into and discussed by those who understood it, the discussion would be reported and get to the ears of others, and thus various people would be set thinking upon it, and it might result in the perfection of a new process. It was not fair, therefore, to the subject, to dismiss it in half-an-hour, when there were many anxious to take part in the discussion, who would have attended if the weather had not been so severe. For instance, there was Mr. J. Arthur Phillips, whose view of Claudet's process he had mentioned in the paper. That process was thought a good deal of in Australia, as one which would come largely into use in treating waste tailings, and Mr. Phillips could tell them more about it in five minutes than he could in a week. He should certainly not have given the account he had of it except with Mr. Phillips's express authority.

Mr. Smedley then moved that the discussion be adjourned to Monday evening.

Mr. Hall seconded the motion, which was carried unanimously, and the meeting adjourned.

CANTOR LECTURES.

SOME POINTS OF CONTACT BETWEEN THE SCIENTIFIC AND ARTISTIC ASPECTS OF POTTERY AND PORCELAIN.

By Prof. A. H. Church, M.A. Oxon., F.C.S.

LECTURE V.—DELIVERED DECEMBER 20, 1880.

Hard Porcelains, European and Oriental.

Whatever independent origins in diverse countries may be assigned to terra-cottas, earthenwares, and stonewares, there can be no question that from Chinese porcelain started all attempts to make true china or hard-paste porcelain. Early efforts in this direction failed, for one or other or all of three reasons—ignorance of the materials used in China, ignorance of their local sources, and ignorance of the composition of the paste, glaze, or colours. Difficulties in manipulation and firing there were indeed, but these proved but minor obstacles when knowledge of the materials* had once been secured. But let me not be misunderstood, for, if the energetic experimenters of the 17th and 18th centuries had succeeded in analysing Oriental porcelain into its constituents—so much silica, so much alumina, so much lime, and so much alkali—they would have been little or no nearer the desired success than before. The qualities or properties which distinguish hard-paste porcelain can be secured only by the association of certain previously formed com
Attempts to imitate the body, by heating t
proportion of the pure constituent oxides t
to the right temperature, have ended in
failure. Heat is obviously not the sole f
the production of this remarkable mate
constituents must be already in some sort s
combined before firing, if they are to
during that treatment the right condition.

This seems to be the fitting place to int
few words about the minute physical or me
structure of hard porcelain. When a thin
is examined under the microscope, certain
ances are presented with a tolerable app
constancy. We may classify these physic
stituents of hard porcelain thus:—

1. Clear paste, the binding material.
2. Opaque rods, called belonites, variou
persed and associated.
3. Minute granules, called spherulites.
4. Quartz or other unchanged miner
ments.
5. Spherical bubbles.

It is very common to find three layer
ental porcelain (*a*) body; (*b*) wash, slip, o
ing; (*c*) glaze. The wash (*b*) is put on as
venient ground for bringing out the colou
usually highly aluminous, and so, whi
from quartz grains and bubbles, is genera
in belonites. These straight-ended, opaq
are associated in ferruginous porcelains w
ous dendritic growths, in which silica is c
with oxide of iron and with lime, as well
alumina.

Before entering into details as to the
elements of Oriental and European ha
porcelains, it will be serviceable if I pr
you a series of analyses, some already pu
and some new, of porcelain bodies and p
clays. On the older analyses implicit relianc
be placed. Methods of separation and est
were imperfect, and the recognition of m
potash, and soda, was frequently most c
I begin by drawing your attention to a
these older analyses of Chinese porcelain:-

	1st Quality.	2nd Quality.	W
Silica	69·0	73·3	
Alumina	23·5	19·3	
Oxide of iron	1·2	2·0	
Lime	·3	·6	
Potash	3·3	2·5	
Soda..............	2·9	2·9	

	Dish.	1st Quality.	Inf
Silica	73·5	71·0	
Alumina	18·5	22·5	
Oxide of iron	·1	1·0	
Lime	trace.	(?)	
Potash	5·0	1·2	
Soda..............	(?)	(?)	

I give for comparison with these figu
analyses I have made of specimens of ancient
porcelain found in a ruined Indian temple

* On this point, the letters of Père d'Entrecolles, 1712-22, constituted most important sources of information.

	a. White body.	b. Brownish body.	c. Glaze of a.
....	75·0	72·0	67·5
ina..........	17·8	17·5	14·5
of iron......	·2	2·5	2·5
....	1·0	1·5	10·0
h...........	4·5	5·0	4·0
....	1·0	1·0	·5
esia	·5	·5	1·0

In looking through these analyses of Chinese ...lain, you will see that the per-centage of silica ...nges over 71, while that of alumina corres...s to a mean of about 21. Let us keep these ...res in mind when we are examining the com...ition of hard European porcelains. We may ...note also the general preponderance of potash ...soda amongst the alkaline constituents of the ...; also the remarkable richness in lime of the ...e example of glaze analysed.

...ming to Japanese porcelain (the manufacture ...ich probably began about A.D. 1513), I have ...er you these two analyses by Mr. H. ...:—

	Eggshell, Sp. Gr. 2·337.	Thick, Sp. Gr. 2·308.
a..............	78·8	74·5
mina............	17·8	19·3
le of iron.......	·6	1·9
e................	·2	·1
sh...............	·2	·6
....	2·0	2·8
nesia...........	trace	·2

...se analyses, the chief feature shown is ...ed higher proportion of soda over potash, ...st to the relative per-centage of these in Chinese porcelains. A detail in the ...ation of Japanese porcelain may be men...ow, namely, the slight firing which the ...ives in the biscuit state previous to the ...ion of underglaze colours and of the glaze; ...gh temperature is used afterwards.

...s gradually accumulating a full series of ...nalyses of Japanese clays, thanks to H. Professor Atkinson, and two other chemists. Würtz found in his examination of Arita ...t the silica oscillated between 74·5 and ...alumina between 14·0 and 19·3 per cent. ...enth analysis the silica was 50, and the ...as high as 38·7—figures under those de... by normal kaolin.

...on's analyses of Japanese clays gave—

		Silica.	Alumina.
ma ..	1	60·7	22·7
..	2	73·1	20·2
..	3	59·4	27·9
..	4	77·2	13·5
..	5	51·8	30·9
..	6	60·3	27·6
yama	1	81·9	11·8
" ..	2	72·0	15·7
" ..	3	70·8	17·8
o ..	1	64·7	22·6
..	2	60·2	23·3
ri		54·6	32·4
		59·1	26·1
to		56·9	28·6

...f these, it will be noticed, is very near the ...ion of our European china clays, and some ...moved from it.

Before speaking of the artistic elements of either Chinese or Japanese porcelain, as illustrated by the specimens on the table, I purpose drawing your attention to that remarkably active period for the European production of hard porcelain, namely, the first half of the 18th century. About the close of the third quarter of the preceding century, Dwight, of Fulham, succeeded in attaining a measure of success, although he had clearly not got hold of the true china clay. But about 35 years afterwards, Bötticher, at Meissen, under the patronage of Augustus II., Elector of Saxony, and King of Poland, first realised in Europe the production of true hard porcelain, equal, if not superior to that of China. It was his knowledge of the proper clay, "Schnorrische weisse Erde," as it is called, found near Aue, Schneeberg, Erzegeberge, which enabled Bötticher to secure success. A chronological list of some of the more important hard porcelain factories, started during the 18th century, presents many features of interest: especially, did time permit, could I show you how the knowledge of the needful materials or ingredients, and where to find them, gradually spread from works to works, generally by workmen who had been discharged, or bribed, had managed to run away with the secret. Thus Vienna got its information from Meissen, Höchst from Vienna, and Berlin from Höchst.

1709. Bötticher, at Meissen.
1718. Stolzel, at Vienna.
1718. Anspach.
1720. Bayreuth.
1740. Ringler, at Höchst.
1744. St. Petersburgh.
1747. Neudeck.
1750. Wegeley, at Berlin.
1753. Baden.
1758. Ludwigsberg, Nymphenberg, and Fulda.
1764. Brancas-Lauraguais at Sèvres.
1768. W. Cookworthy, at Plymouth.

Besides all these manufactories of hard paste, many others were established in Germany, France, Switzerland, and Holland, towards the close of the last century.

It will be of interest if I now present you with some analyses of European hard porcelains. We shall be able to discern the chemical differences which sever them from oriental wares; and we shall see that these differences, if they do nothing more, at least give us the means of overthrowing such an egregious fancy as that which has attributed to Lowestoft, in Suffolk, the manufacture of tens of thousands of pieces of inferior Chinese porcelain. Analysis shows at once the absolute identity of duly authenticated pieces of hard Lowestoft, with similar pieces known to have been made in China.

Beginning with Dwight's semi-porcelain made at Fulham, a fragment of an authentic specimen from the Reynolds "collection" gave the following numbers, clearly showing that Dwight had not introduced kaolin into his ware:—

	Per cent.
Silica............................	79·5
Alumina	12·5
Oxide of iron	1·0
Lime............................	1·5
Potash	3·0
Soda	1·5

I now give a series of analyses representing the composition of many Continental porcelains:—

	Berlin (1808.)	Berlin.	Meissen (1825.)
Silica	66·6	71·3	57·7
Alumina	28·0	23·7	36·0
Oxide of iron	·7	1·7	·8
Lime	·3	·6	·3
Potash	3·4	2·0	5·2
Soda	(?)	·6	(?)

	Bohemia.	Nymphenburg.	Vienna (1806).
Silica	74·8	72·8	61·5
Alumina	21·1	18·4	31·6
Oxide of iron	(?)	2·5	·8
Lime	·6	3·3	1·8
Potash	2·5	·6	2·2
Soda	·6	1·8	—
Magnesia	—	—	1·4

Since the time when hard paste almost, if not quite, completely displaced *pâte tendre* at Sèvres, the composition both of the body and the glaze there has remained constant, except for special purposes. The body is so made up, after analysing the ingredients, as to contain, per 100 parts:—Silica, 58; alumina, 34; lime, 4·5; potash, 3·; magnesia and soda, ·5. In order to secure this composition, 73 of kaolin, 24 of felspathic sand, and 3 of lime, were used in 1839. In 1843, the per-centages taken of these three ingredients were respectively 48, 48, and 4. The Sèvres glaze is now obtained with the china-stone of St. Yrieix. Its composition may be gathered from these partial analyses:—

	1826.	1839.	1841.
Silica	73·0	73·4	74·3
Alumina	16·2	15·7	18·3
Potash	8·4	7·4	6·5

It will be remembered that the ascendancy of hard paste at Sèvres dates from 1768. Efforts by the royal factory to buy the secret of kaolin from foreigners had failed, when, as the story goes, Madame Darnet, wife of a surgeon, of St. Yrieix la Perche, found a white clay for cleaning linen in a neighbouring ravine. M. Darnet showed this to M. Villaris, a druggist, of Bordeaux, who recognised in it the long-desired kaolin. He sent the substance to M. Macquer, the chemist of Sèvres, who obtained an identical substance at St. Yrieix in August, 1765, and in June, 1769, read a memoir, illustrated with specimens, on "Porcelaine dure Française."

A peculiar interest is attached to the excessively rare porcelain made by the Comte de Brancas-Lauraguais. He began, about 1758, discovering the kaolin of Alençon. He worked at Sèvres, and probably also at Chelsea. He was acquainted with the china clay and china stone resources of Cornwall. His English patent, for hard or true china, was taken out in June, 1766, but his invention was never specified. He thus anticipated W. Cookworthy's patent by two years. Brancas-Lauraguais and his porcelain are named in the *Scot's Magazine* for 1764, by Dr. Erasmus Darwin, in a letter to Josiah Wedgwood; and by the Abbé Raynal. Horace Walpole posse
celain reproduction, by the Count, of t
of Michel Angelo. In M. Gasnault's
there is a medallion dated "Octobre, 1
Rouen Museum possesses a specimen l
date Septembre, 1768. The Musée Ce
Sèvres has no less than three pieces c
Lauraguais porcelain. M. Jules Vallet
with coloured decoration in an Oriental
late M. Jacquemart owned a cup.
three specimens in the Alexandra Pa
were destroyed in the disastrous fire of
One of these last-named pieces was a
or tea-poy; its decoration of flowers re
forcibly of that of Chelsea, period 2
was fine, hard, and of good colour; alt
specimen showed to what a degree o
the Count had brought his invention.
analysis of a fragment of a twisted
this porcelain, with the following resu

	In 100 parts.	
Silica	58	Spec. g
Alumina	36	
Oxide of iron	1	
Lime	1	
Potash	3	
Soda	1	

The kaolinic character of this ware is
I have to direct your attention now
manufactory of hard paste porcelain i
which attained any considerable degre
We may call it, perhaps, "Plymouth—
company was started in Bristol, as ea
for making china from Cornish mat
Plymouth factory began in 1768
Champion added the latter to his c
works in 1773, continuing the manuf
1781. No doubt W. Cookworthy had
china clay long prior to the earliest of t
but ceramic chronicles constantly sho
interval between china clay and china
very wide one.

An analysis of Champion's Bristo
gave me—

Silica	
Alumina	
Lime	
Potash and soda	

Cookworthy mentions that the ka
Stephen's burns, to a degree of transpa
without the addition of china stone; bu
analysis indicates, as we should expect
stone was a normal ingredient of I
celain. Cookworthy used, for glaz
having green spots, from Tregonnin-
when he wanted a more fusible mixture
1 part of lime, and 2 of fern-ashes, to 30
the above china stone. Kaolin, pip
sand were used as safeguards in the kil

It will be useful if I now give you
about kaolin, although time forbids n
into full details concerning this substa
kaolin always completely formed, and
rived from the decomposition of the sa
it would exhibit a greater constancy
tion and properties than is the case.
clays, it is true, a substance of apparen
mineral rank has been isolated, and i
kaolinite. But if a substance of this

nmon constituent (often the chief consti- of china clays, yet the existence of ious silicates of different composition, evertheless adapted for porcelain-making proved by the analyses of many of the tal clays used in this manufacture; it must be borne in mind that china roper, or kaolinite, as it occurs in nature, ver free from traces at least of iron, lime, esia, potash, and soda, none of which enter into mula, but are proofs of the incompleteness of process by which it has been formed. Indeed, accidental constituents may reach a sum of per cent. of the total weight of the kaolin. linite, it should be stated, is assumed to possess following per-centage composition :—Silica, ; alumina, 39·8; water, 13·9. The greater of the water needs a temperature above 212° expel it.

ould now direct your attention to the indi- specimens of hard-paste porcelain on the But a few words seem necessary concerning highly felspathic bodies which come so e hard china, that they may well be men- iow. The most notable of these is that d by L. Solon for the decoration of his d *pâte sur pâte* pieces. Thanks to Messrs. I am able to show you four specimens of t refined and lovely work. It is mar- o see Mr. Solon, as I have been to see him, without outlines or previous laying the wet porcellanous slip with a the coloured ware in the green state, and ng the powdery substance into forms of truth and tenderness. If you examine nen of this artist's work, this pilgrims' 1 will, I trust, agree with me that the ch has yet to be applied, will be very far oving the artistic qualities of the surface, the colour, and the design of the piece But the manufacturers have their own covering fine work with glaze; and the purchasers, for the most part, have no to the glazing layer which, if it protects, ils and even modifies the body and its . Some day, let us hope, a surface like Wedgwood's finest jasper will permit quisite work to be thoroughly enjoyed. ere some tiles and a jug, which under the crystal porcelain," have been lent to me ng. It is a hard, apparently felspathic resembling Wedgwood's jasper bodies, closely in appearance, and in the quality ıg coloured oxides into intimate union mass. From these examples I judge use may be made of this material for hose designs in which softness and rich- desirable without having recourse to

turer concluded by noticing the chemical cal characteristics, so far as they threw n the decorative qualities, of a large specimens of Continental and English porcelains, chiefly contributed by Mr. He then examined and explained from standpoint—crackle porcelain, blue , Chinese porcelain with black, coloured, d glazes, noticing especially the céladon, ruby, and opaque canary and mustard ours. He showed how a pure good cobalt blue is revealed by means of the light from burning magnesium. He spoke also of the various kinds of Oriental white or uncoloured porcelain, and of the methods of decorating it by incised work in the paste. The fertility and skill of the Chinese, as shown in their splashed, mottled, and sprinkled glazes, was touched upon.]

MISCELLANEOUS.

CITY OF LONDON COLLEGE.

The prizes and certificates gained by the students at the annual examinations of the City of London College, the Society of Arts, and the Government Department of Science and Art, were distributed on the 4th of January, at the College, in Leadenhall-street, by the Right Hon. A. J. Mundella, M.P., the Lord Mayor being also present. Having distributed the prizes,

Mr. Mundella first directed his remarks to the students, and then addressing the Lord Mayor, observed that it was a matter of great rejoicing to him that the Corporation of the City of London had, during the past few months, made a step in the right direction. They had voted £10,000 towards the new technical guilds to be established at South Kensington, and £2,000 a year for some years, and he saw that the great City guilds, whose names were identified with our British industries, and which had presided over their infancy, but had long ceased to have any connection with them but their name, had recently taken it in hand to improve the skill, industry, and force of the British workman. He, however, thought it was only right to say that the sum which had been raised, £50,000 for building, and £5,000 for sustenance, was altogether inadequate, and if the City of London and the guilds of London were to do anything worthy of their name and position, they must do far more. The sum mentioned was not sufficient for the sustenance of the laboratory. A single institution in a German town had spent £60,000 on the laboratory added to it last year. He knew second and third rate towns spread over the continent of Europe which had spent in the last four or five years double the sum which was supposed to be sufficient to represent the great City of London. The Corporation could do no better work than affiliate this institution to their new college. Mr. Mundella then pointed out what great manufacturers had done for technical instruction in Sheffield, in Leeds, in Dundee, and in Birmingham, and alluded to the noble works done in Manchester and Liverpool; and he urged the merchants of London to follow the example of local towns, and immediately provide a suitable home for the college as good as what the small town of Keighley, in Yorkshire, had done for its locality.

Sir Henry Cole, in responding for thanks to the Society of Arts, which had helped to give the college its present name in 1853, showed how much the Society had acted as the pioneer of all the existing examinations. Now the great growth of public education had left the Society to examine only in Political Economy and Domestic Economy and Music. To discuss Domestic Economy in education, and show how much it was women's especial work rather than men's, a congress would be held in the summer, when distinguished ladies would be the chief workers at the congress. He congratulated Mr. Mundella on his public declarations to decentralise public education.

Before the meeting ended, the **Lord Mayor** stated that he would summon a meeting in the City to advocate the claims of the college to have a suitable building, and Mr. Mundella promised to attend it.

ST. GOTHARD RAILWAY.

An account of the Leggestein spiral tunnel, which is one of the most remarkable works in connection with the St. Gothard Railway, has been communicated to the *Daily News* by the Geneva correspondent of that paper.

"The leading feature of the scheme adopted by the engineers in constructing the line has been to keep to the bottom of the valleys—on the north side of the Alps, the valley of the Reuss; on the south side, that of Ticino—and, so long as they did not deviate too widely from the required direction, to follow their windings until the point fixed for the entrance of the great tunnel should be reached. When this could not be done, and it became necessary to carry the railroad higher, spiral, or to use the German term, 'turn tunnels,' were to be pierced through the mountains. These tunnels made at once a steep gradient and a sharp curve. The gradient of the Leggestein tunnel is 23 in the 1,000, and it describes a curve of 300 mètres. After leaving it, the line winds spirally outside the mountain, and passing through a shorter passage higher up, reaches the required altitude. The construction of this tunnel was difficult, less on account of its length, which is nothing extraordinary, than owing to the necessity of boring entirely by hand through a mass of almost impenetrable granite. The progress made at the outset did not exceed three décimètres (twelve inches) in twenty-four hours, even with the aid of blasting. The necessity of handwork arose from the absence of water, and the impossibility, in the circumstances, of using steam for the perforators. Two other turn tunnels—in the valley of the Reuss that of Wellington, 1,000 mètres long, and that of Pfaffensburg, 1,000 mètres long—will be completed during the coming spring. The former, like the Leggestein, is being bored by hand, the latter by water power. On the south side, in the valley of the Ticino, there are four tunnels (which are to alpine railways what locks are to canals), of from 1,500 to 1,600 mètres long, now in course of construction. All these are being bored by water power, and like those on the north side are expected to be finished early in 1881. It is intended to light the great tunnel by electricity. To this end two systems have been proposed. One is to place in the passage 40 electric lamps, each possessing a capacity of 1,200 candles. The interval between each lamp would be about 400 yards, and the necessary motive power would be supplied by the turbines at Airolo and Goeschenen, which have been used for moving the perforators and ventilating the workings. The second proposal, whether it be practicable or not, has certainly the merit of greater originality. According to this scheme, a locomotive impelled by compressed air would be stationed at either portal of the tunnel. These locomotives, being smokeless, would be used for drawing the trains through the tunnel. Each locomotive would carry two electric lamps, and two would be placed at the end of the train, together with reflectors, so arranged that their united light would be equal to that of 12,000 candles. By this means, wherever there was a train, and for a considerable distance before and behind it, the tunnel would be brilliantly lighted at a comparatively trifling expense, the electricity being produced and the engines provided with their motive power by the turbines at Greschenen and Airolo."

CORRESPONDENCE.

BREAD REFORM.

Dr. J. H. Gilbert, F.R.S., writes to the Secretary of the Society regretting his inability, on account of pressure of other work, to read a paper at the Society of Arts during this present Session, and goes on to say:—"If I had any spare time for such a purpose, I should be disposed to discuss the important food question of the so-called bread reform. Many years ago Mr. Lawes and myself went somewhat fully into some of the questions involved (*Journal of the Chemical Society*, vol. x., 1857). We showed the distribution of the nitrogen, the total mineral matter, the phosphoric acid, &c., in the different mill products from wheat grain. It is true that about three-fourths only of the total nitrogen of the grain are found in ordinary bread-flour, the remaining one-fourth or so being retained in the excluded portions, which latter are richer in nitrogen than the flour. But it has long been known that a considerable part of the nitrogenous matters of the excluded portions is not in the same condition as those in the flour, and it is stated that they are in an inferior degree digestible and available. Recent investigations show that only from two-thirds to three-fourths exist in the albuminoid condition; and it is as yet not known whether, or in what degree, the non-albuminoid nitrogenous bodies are of nutritive value. So far as they are not, the value of the excluded portions is proportionately reduced (so far as this is dependent on the nitrogenous compounds), and it may be even lower instead of higher, for a given weight, than in the flour. Of the phosphoric acid of the grain, it may be said that not more than about one-third will be found in the bread-flour. And, although I am not aware that the point has been proved, it may be that the flour is in a greater degree deficient in a due proportion of phosphoric acid than of nutritive nitrogenous compounds; and, if this be the case, it is a question whether it would not be better to add phosphoric acid in the process of bread-making (as is sometimes done in America) than to include the whole of the more phosphatic portions of the grain. For, if these were supplied in a coarsely-ground state, there would be waste of ... its passage through the body unused; and, if so ground as to avoid the aperient action, it is a question whether evil would not then arise from the ... earthy (and especially magnesia) phosphate, causing accumulation and concretion. Indeed, notwithstanding the exclusion of so much of the nitrogen and phosphoric acid of the grain from ordinary bread-flour, we nevertheless came to the conclusion that such flour was better than whole-meal bread, for the reasons that the nitrogenous matters of the excluded portions were of less nutritive value; that those portions contained a considerable amount of indigestible woody matter; that the branny particles so increased the peristaltic action as to cause the passage from the body of a large amount of the food unused. In reference to the points which are now again brought so prominently forward, we said, in the paper above referred to (pp. ...)

"'The higher per-centage of nitrogen in bran than in fine flour has frequently led to the recommendation of the coarser breads as more nutritious than the finer. We have already seen that the more branny portions of the grain also contain a much larger per-centage of mineral matter. . . . . It is, however, we think, very questionable whether, upon such data alone, any opinion can be formed of the comparative value, as food, of bread made from the finer or coarser flour of one and the same grain. . . . . Again, it is an indisputable fact that branny particles, when admitted into the flour in the degree of imperfect division which our ordinary milling processes leave them, considerably increase the peristaltic action, and the alimentary canal is cleared much more rapidly of its contents. It is also well known that the poorer classes almost invariably prefer the whiter bread; and among some of them who work the hardest, and who, consequently, would soonest appreciate a difference in nutritive value (navvies for example), it is distinctly stated that preference for the whiter bread is founded on the ...

browner passes through them too rapidly, con-y before their systems have extracted from it as atritious matter as it ought to yield them. It is granted that much useful nutritious matter is, first instance, lost as human food, in the amount of 15 to 20 per cent. of our wheat-to the lower animals. It should be remem-, however, that the amount of food so applied no means entirely wasted. And further, we it more than doubtful, even admitting that an sed proportion of mineral and nitrogenous consti-would be an advantage, whether, unless the branny could be either excluded, or so reduced as to the clearing action above alluded to, more would not be lost to the system by this would be gained by the introduction into coincidentally with it, of a larger actual supposed nutritious matters. In fact, all ex-tends to show that the state, as well as the composition of our food, must be considered; words, that its digestibility, and aptitude for tion, are not less important qualities than its composition.'

course, if the branny portions were reduced to state of fineness, and it were found that this the aperient action, and that other evils were ed, or, better still, if more of the food material eparated from the bran, and in either case more cost than the saving would be worth, ht be some advantage. But, to suppose that eat meal, as ordinarily prepared, is, as has been assumed, weight for weight, more than ordinary bread-flour, is an utter fallacy, a theoretical text-book dicta; not only en-pported by experience, but inconsistent with it, it is just the poorer fed and the harder that should have the ordinary flour bread the whole-meal bread as hitherto prepared, the over-fed and the sedentary that should whole-meal bread. Lastly, if the whole finely ground, it is by no means certain percentage of really nutritive nitrogenous ould be higher than in ordinary bread-flour, uite a question whether the excess of earthy would not then be injurious."

ert adds that Mr. J. B. Lawes concurs with opinions stated.

...TION CODE REFORM PROSPECTS.

...as a member of the Society, to call attention pect of extensive changes in the principles of code, which is unintelligible except to tech-ts, like the Education Inspectors and staff at and not very clear to them. I send ex-speeches recently made by Mr. Mundella, President, who is reported, on the 1st Decem-to have said at Huddersfield, "As Vice-of the Council, he was not disposed to treat rities as if they were children in leading He wished School Boards to be responsible re to the ratepayers and rather less to the Department." On the 15th December, 1880, ella said, at Sheffield, "What he wished was ore responsibility upon the locality and less Education Department;" and on the 29th 1880, he said, at the Borough-road College ritish and Foreign School Society, "He educators desired for the teachers the possible freedom in their teaching, from all unnecessary routine." The the 31st August, 1879, given in the port, were as follows:—"The schools ob-5,078 by endowment, £636,792 from rates, by voluntary contributions, £1,349,297 by es, and £24,066 paid by Guardians of the Poor, making a total of £2,899,366. The Government grant was £1,828,702; all these sums, with £48,841 from other sources, making a total of £4,776,914. Of this the local contributions amounted to £2,948,207, whilst the Government grants were only £1,828,707." Thus it appears that the local funds spent on elementary education were upwards of £1,100,000 more than the Government grant. If Mr. Mundella's excellent intentions are fulfilled, it may be hoped that the present "leading strings" imposed on local authorities will be relaxed in due proportion.

F. S.

SIGNALLING BY MEANS OF SOUND.

I was not present when the paper by Mr. Price Edwards, on signalling by means of sound, was read, on the 15th ult., but I have read with interest the report in your *Journal*, and, if permitted, should like to offer a few remarks upon it.

Mr. Price Edwards approves a system of sound signals based on distinctions obtained by making blasts to occur in groups of one, two, three, or four blasts at a time, with varying intervals of half a minute, one, two, or three minutes between the groups of blasts. Sixteen distinct signals are thus obtained.

In the discussion which followed the paper, Mr. Preece supported the proposal made by Sir William Thomson to use a system based on that of telegraphy, using long and short sounds, as in the Morse system, but no one present at the meeting seems to have mentioned the plain numerical system of signals proposed in 1851 by my father, the late Charles Babbage, applicable both to light and sound. It was published in 1851, and was communicated to the Trinity House in November of that year. It was reported on by the Lighthouse Commission of the United States, whose report was printed and published in 1852.

By that system every lighthouse in the world would have its own number, which would be continually repeated, either by light or sound, as long as necessary. Thus, if the lighthouse was numbered 73, there would be during foggy weather seven blasts at short intervals, then a pause; then three blasts, and a longer pause; after which, the same would be repeated as long as the fog lasted. The number of the lighthouse could thus be repeated in less than 30 seconds, and as the lighthouses on either side would be arranged with numbers not having the same digits (say, for example, 25 and 48), the counting of *one* digit would in most cases indicate the lighthouse, and the counting of the *second* would afford a check, and give positive assurance of the correctness of the observation, if it was found to tally with the number found on the chart. In this system nothing else has to be done beyond counting the number of the blasts; no previous knowledge whatever is requisite, and a glance at the chart tells everything wanted; surely this is within the intellect of almost any sailor of any nation able to use a chart.

Now, contrast this with the other two systems. In the Morse system, the sailor must observe, not only the length of each and every blast, but he must also watch the sequence of the long and short blasts, and he must know the combinations of them which represent each numeral, before he can be sure of the number of the lighthouse before him, and find it on his chart. It is true that the Morse spstem is used for the heliograph and army signalling, and also in the Royal Navy for night signalling, but I believe that a specially instructed staff is required in all cases to work it, and that by all others it is found quite impracticable.

In the Trinity House system also, not only must the number of the blasts be counted, but the interval between each group must be measured, and how often would mistakes be made in this during the anxious

moments of danger, when, at any instant, the ship might strike and go to the bottom. Then, supposing the observation correctly made, the mariner would have to search on his chart, not for a simple number alone, but for the comparatively complex characteristics which he has observed, and which would not meet his eye so readily as a simple number; perhaps, if a foreigner, he might not be able to read it at all. Besides these very serious defects, the Trinity House system provides only sixteen signals, of which four only are repeated within the half-minute, and four of them require as much as three minutes; but, in these days of steam, what might not happen from ignorance of the identity of the light-house for three, two, or even one minute! Then, again, unless the number of the lighthouse was different for light and for sound (which would be very unadvisable), restricting the number to sixteen for fog signals, would similarly restrict it for light also.

It seems to me that the simple numerical system has advantages over every other yet proposed, and it is capable of being gradually introduced. Until it has been fairly tried, it should not be rejected by the Trinity House. The expense of setting up one, say somewhere towards the mouth of the Thames, where many could see and hear it, would not be thrown away.

Henry P. Babbage.

Bromley, Kent.

SANITARY INSPECTION.

There are one or two points in Professor Fleeming Jenkin's paper and the discussion upon "A Sanitary Protection Association for London," about which I should like to make a few remarks. The most serious objection to the whole scheme is that, on the face of it, the first expense, namely, the small subscription, is but the prelude to heavier outlay, and that the great majority of persons, whose means would necessitate their taking advantage of the association, could not afford to carry out the works which would be recommended, even if they had a sufficient interest in the property they occupy to justify the expenditure. These would only be dissatisfied with their houses without reasonable opportunity of putting right the imperfections revealed to them, and, in most cases, it would be better for them never to have had a question raised. When anything is radically wrong, the proposed inspection by the association would only lead to the employment of other professional assistance, and no saving would be effected. Again, professors of sanitary matters are so utterly at variance upon what they individually consider to be vital questions, that the public could not place anything like implicit reliance upon the reports furnished them, and would more often than not find those called in to remedy alleged evils disagree altogether with the advice given by the official of the association. Further, there is the difficulty to be encountered with local Boards and Vestries, who often will not sanction what might be considered, from a sanitary point of view, the best modes of dealing with drainage. To illustrate this, I may mention that I am one of those dreadful persons who let land to suburban builders of the speculating class for the erection of small dwellings. Nevertheless, in all cases in which it is reasonably practicable, I should like even these buildings to be constructed on sanitary principles; and with regard to one parcel of ground, my common-sense led me to the opinion stated by Mr. Rawlinson, that "when houses were dealt with as they ought to be, there would be no drain-pipes within them." This piece of ground is surrounded on three sides by roads, in which there is no sewer. This necessitates the construction of a sewer through the middle of the ground, and my desire was to drain all the houses into this through their gardens, and so that no drain-pipes should run under any house. The local authorities, however, would not allow me to do so, and insisted on the usual drainage through the houses, with regard to those fronting roads having sewers. Consequently, in a row of houses which might have all been drained from the back without any pipes under the house, every alternate house has its drain (carrying its sewerage and that of the adjoining house) running underneath the parlours, with the danger at any time of breakage, and the escape of noxious gases, and the unpleasant necessity, in case of stoppage of the pipes, of opening up the drain inside the house. There may be some power by which I could have insisted upon permission being given to drain in the proper way, but it would not have done for me to have exercised it, being so impolitic to go against local authorities.

I notice, too, that one of the speakers "had felt strongly for many years the helpless condition in which tenants were placed with regard to these matters." This is to some extent true, though looking at the great number of unlet houses they have to choose from, it is only partially so. But the fact is that the ordinary run of tenants do not care, and will not pay for properly constructed houses. A hideous burlesque of grand style of architecture, applied to £30 a year houses, will often let them readily, though inside they may be, but "whited sepulchres." Hundreds of sensibly-built houses stand empty because "they are not pretty enough." Again, the honest builder who spends, say £300 to £320 in building a £30 a year house, gets only the same rent as the jerry builder, who has constructed houses, similar in appearance, at about two-thirds of that cost. The real remedy for the present wretched system of building is a revival of the custom, which I have heard used to obtain in town, and largely exists still in country places, of persons having houses built for them, instead of buying and renting ready-built houses. The question of cost would then be more fairly adjustable to the value obtained.

Finally, let us insist upon cleanliness and sanitation with such means as are at hand. Let closets and sinks be frequently flushed and windows opened. In short, let the elementary principles of domestic management, now happily being taught to the poorest children in our Board schools, be practically applied. In the meantime let professors of sanitation and patentees of sanitary appliances (many of which, let us honestly admit, are good and valuable; but many more of which are absurd and worthless) fight out their wordy strife as they will, and perhaps, even they some day may come to agree upon what are the "principles of sanitation"—principles which, up to now, I have vainly endeavoured to glean from either their lips or their pens.

Jas. Ball.

East Dulwich, 17th January, 1881.

NOTES ON BOOKS.

Association Internationale pour l'Eau Potable. Séance Générale tenue à Turin le Jeudi, 9 Septembre, 1880, à l'Occasion du Troisième Congrès International d'Hygiène. Amsterdam, 1880.

This volume consists of the address of the President, Mr. J. G. Jäger, and the report of the proceedings of the meeting held on the 9th of September. The association grew out of the work of the International Congress of Hygiene, and was formed in Holland with the object of finding an answer to the question put by King William III. to his ministers at the period of the cholera epidemic of 1866. The question of the King was to this effect—whether the quality of drinking water has any influence over the spread of cholera, and, that influence being admitted, whether the State should intervene, or whether the matter should be left to the care of

norities. After considerable discussion, the nanimously passed a resolution, affirming that ssary for the Central Government to interrder that the good quality of drinking water e assured. Mr. Jäger specially alluded to the f the Select Committee on the Water Supply of , the account of which he quoted from the *of the Society of Arts.*

s and Catalogue of Cabinet and Upholstery iture, Looking-glasses, &c. London: C. and R. t, Curtain-road, 1880.

s large folio volume contains one thousand nine nd and eighty designs for articles of furniture great variety of styles, which are arranged under adings of hall, library, dining room and parlour, g-room, bedroom, camp and ship, kitchen, and . The information given in this book is so d as to be practically useful to those who designs for furniture, such as are called for wants of the present day. Prefixed are Notes on Household Furniture," which conight sketch of the changes that have taken the fashion of British furniture from the the Saxons, when little more was found than a series of benches and a heavy table h the dwellers in the house and the guests ght, down to the present time when furniture s Early English, Mediæval Gothic, Renaislian, Venetian, Louis XIV., Louis XVI, e, Chippendale, Neo-Greek, and Japanese, eir different admirers. Special mention is r William Chambers, the architect, Thomas e and Thomas Sheraton, the cabinet-makers, s Hope, the connoisseur, whose works greatly the fashion of domestic furniture in Engppendale's "Gentleman and Cabinet-maker's was published in the year 1759, and have suffered from some adverse criticism. ity of the designs are of that pure and rather e which is associated with his name, but lso specimens of florid ornamentation in the ench taste adapted to frames and cornices ously enough are now often referred to as Chippendale work. Sheraton's "Cabinet-Upholsterers' Drawing Book" appeared in rst volume being devoted to the science, and the the art of the cabinet-maker's trade. Mr. ume, entitled "Household Furniture and Inration," was published in 1807, and contained nber of designs in a purely classical style. His t in directing attention to this subject was furniture which should harmonise with the is collection of antiquities. The critics, ord Jeffrey of the *Edinburgh Review*, laughed ior, but in spite of opposition the book exerted ide influence. The introduction to Messrs. ook also contains some remarks upon the the several articles of furniture appropriate ous rooms.

GENERAL NOTES.

gical Museum at Sidney.—A Technological, and Sanitary Museum for New South Wales is ed at Sidney. This museum is intended to milar position and fulfil the same purpose in that e South Kensington Museum, the Bethnal-green the Museum of Practical Geology, the Patentum, and the Parkes Museum of Hygiene do in To this end, it is intended to collect together ections of all materials of economic value belonging to the animal, vegetable, and mineral kingdoms, from the raw material through the various stages of manufacture, to the final product or finished article ready for use. The following are the chief subjects which will be represented:—1. Animal products. 2. Vegetable products. 3. Waste products. 4. Foods, animal and vegetable. 5. Economic entomology. 6. Economic geological specimens, showing the ores of the metals, their manufacture and uses; building and ornamental stones, clays, cements, glass, pottery, porcelain, pigments, &c. 7. Educational apparatus and appliances, school fittings, books, maps, diagrams, &c. 8. Sanitary and hygienic appliances and systems. 9. Mining, engineering, and machinery. 10. Agricultural tools, appliances, and machinery; also soils, manures, &c. 11. Models, drawings, and descriptions of patents. 12. Ethnological specimens. 13. Examples of historical furniture and of artistic workmanship in iron and other metals. 14. Photographs, electrotype, plaster, and other reproductions of examples of art workmanship where originals are not to be obtained. 15. Exhibition catalogues, trade journals, price lists, and descriptions of new processes or industries. The acting-secretary, Mr. Charles R. Buckland, asks for contributions to the museum.

MEETINGS OF THE SOCIETY.

ADJOURNED MEETING.

Monday evening, at eight o'clock:—

JANUARY 24.—Discussion on Mr. A. G. Lock's paper, "Causes of Success and Failure in Modern Gold Mining." HYDE CLARKE, Esq., will preside.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock:—

JANUARY 26.—"Suggestions for Preventing London Smoke." By W. D. SCOTT-MONCRIEFF.

FEBRUARY 2.—"Trade Prospects." By STEPHEN BOURNE.

FEBRUARY 9.—"The Present Condition of the Art of Wood-carving in England." By J. HUNGERFORD POLLEN. Sir PHILIP CUNLIFFE OWEN, C.B., K.C.S.I., will preside.

FEBRUARY 16.—"The Participation of Labour in the Profits of Enterprise." By SEDLEY TAYLOR, M.A., late Fellow of Trinity College, Cambridge.

FEBRUARY 23.—

MARCH 2.—"Flashing Signals for Lighthouses." By Sir WILLIAM THOMSON, LL.D., F.R.S.

MARCH 9.—"Improvements in the Treatment of Esparto for the Manufacture of Paper." By WILLIAM ARNOT, F.C.S.

MARCH 16.—"The Manufacture of Aërated Waters." By T. P. BRUCE WARREN.

MARCH 23.—"The Increasing Number of Deaths from Explosions, with an Examination of the Causes" By CORNELIUS WALFORD.

MARCH 30.—"Recent Advances in Electric Lighting." By W. H. PREECE, Pres. Soc. Tel. Eng.

Dates not yet fixed:—

"Buying and Selling; its Nature and its Tools." By Prof. BONAMY PRICE. On this evening Lord ALFRED S. CHURCHILL will preside.

"The Discrimination and Artistic Use of Precious Stones." By Prof. A. H. CHURCH, F.C.S.

"The Compound Air Engine." By Col. F. BEAUMONT, R.E.

FOREIGN AND COLONIAL SECTION.

Tuesday evenings, at eight o'clock:—

FEBRUARY 1.—"The Industrial Products of South Africa." By the Right Honourable Sir HENRY BARTLE

Frere, Bart., G.C.B., G.C.S.I., D.C.L., LL.D. Sir Richard Temple, Bart., G.C.S.I., C.I.E., D.C.L., will preside.

February 22.—"The Languages of South Africa." By Robert N. Cust.

March 15.—"The Loo Choo Islands." By Consul John A. Gubbins.

April 5.—"Trade Relations between Great Britain and her Dependencies." By William Westgarth.

Applied Chemistry and Physics Section.

Thursday evenings, at eight o'clock:—

January 27.—"A New Mechanical Furnace, and a Continuous System of Manufacturing Sulphate of Soda." By James Mactear, F.C.S. J. C. Stevenson, M.P., will preside.

February 24.—"Deep Sea Investigation. and the Apparatus used in it." By J. G. Buchanan, F.R.S.E., F.C.S.

March 24.—"The Future Development of Electrical Appliances." By Prof. John Perry.

Indian Section.

Friday evenings, at eight o'clock:—

January 21.—"Forest Conservancy in India." By Sir Richard Temple, Bart., G.C.S.I., C.I.E., D.C.L. Andrew Cassels, Member of Council, will preside.

February 11.—"The Gold Fields of India." By Hyde Clarke.

March 4.—"The Results of British Rule in India." By J. M. Maclean.

March 25.—"The Tenure and Cultivation of Land in India." By Sir George Campbell, K.C.S.I., M.P.

May 13.—"Burmah." By General Sir Arthur Phayre, G.C.M.G., K.C.S.I., C.B.

Cantor Lectures.

Monday evenings, at eight o'clock:—

The Second Course will be on "Watchmaking," by Edward Rigg, M.A. Three Lectures.

Syllabus of the Course.

Lecture I.—February 7.

Introduction—Units of Time—Historical Sketch—Description of usual forms of watch—Escapements—Conditions of accurate timekeeping, and arrangements necessary for their maintenance in the higher class of watch.

Lecture II.—February 14.

The ordinary watch—Degree of accuracy required in it—Systems of manufacture in this country and abroad—Description of specimens illustrative of the various stages of construction—Comparison of the several systems.

Lecture III.—February 21.

Necessity of efforts to promote the art in this country—Need of education, theoretical and practical, in horology—Literature—Great want of uniformity in gauges. screws, &c.—Exhibition of ordinary and complicated watches, and of watchmakers' tools—Conclusion.

The Lectures will be illustrated by Specimens, Models, and Diagrams. The different movements, &c., will be shown enlarged on the screen by means of the Aphengiscope and the Electric Light.

The Third Course will be on "The Scientific Principles involved in Electric Lighting," by Prof. W. G. Adams, F.R.S. Four Lectures.

March 7, 14, 21, 28.

The Fourth Course will be on "The A making," by Alan S. Cole. Three Le

April 25; May 2, 9.

The Fifth Course will be on "Colou and its Influence upon Various Indu R. Brudenell Carter, F.R.C.S. Thr

May 16, 23, 30.

Admission to Meetings.

Members have the right of attendi Society's meetings and lectures. Eve can admit *two* friends to the Ordinary an Meetings, and *one* friend to the Canto Books of tickets for the purpose have to the Members, but admission can also on the personal introduction of a Meml

MEETINGS FOR THE ENSUING W

Monday, Jan. 24th...SOCIETY OF ARTS, John-s W.C., 8 p.m. Adjourned discussion Lock's paper, "Causes of Success an Modern Gold Mining."
Royal United Service Institute, Whitehall- Capt. L. K. Scott, "Suggestions for Impro and Artillery Fire, combined with an E Capt. Scott's system of Sighting Gu illustrated by models."
Medical, 11, Chandos-street, W., 8½ p.m.
Royal Asiatic, 22, Albemarle-street, W., 3
London Institution, Finsbury-circus, E.C. E. B. Tylor, "Problems in the History of

Tuesday, Jan. 25th...Royal Institution, Albemarl 3 p.m. Prof. E. A. Schäfer, "The Blood.'
Medical and Chirurgical, 53, Berners-st street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on "Deep Wi in South Wales."
Anthropological Institute, 4, St. Martin' 8 p.m. Annual Meeting.
Royal Colonial, the Grosvenor Gallery Lib Bond-street, W., 8 p.m. Sir Alexande Future of Canada."

Wednesday, Jan. 26th...SOCIETY OF ARTS Adelphi, W.C., 8 p.m. Mr. W. D. Sc "Suggestions for Preventing London Sm
Telegraph Engineers and Electricians, 4, Br S.W. 1. Inaugural Address by the Pres C. Foster. 2. "Mr. A. W. Heaviside, " ments on Induction with the Telephone.'
Royal Society of Literature, 4, St. Martin' 8 p.m. Mr. Robert N. Cust, "A Recent with Notices of the Al Hamra and of Spa

Thursday, Jan. 27th...SOCIETY OF ARTS Adelphi, W.C., 8 p.m. (Chemical Section Mactear, "A New Mechanical Furnac tinuous System of Manufacturing Sulphs
Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m
London Institution, Finsbury-circus, E.C., H. E. Armstrong, "The Manufacture o Coal."
Royal Institution, Albemarle-street, W., Francis Hueffer, "The Troubadours."
Inventors' Institute, 4, St. Martin's-place,
Royal Society Club, Willis's-rooms, St. J 6 p.m.

Friday, Jan. 28th...Royal United Service Instit hall-yard, 3 p.m. Colonel Thomas Innes ing of Militia."
Royal Institution, Albemarle-street, W., Arthur Schuster, "The Teachings Spectroscopy."
Quekett Microscopical Club, University Co p.m. 1. Mr. B. W. Priest, "Sponges." Cobbold, "*Filariæ*."
Clinical, 53, Berners-street, W., 8½ p.m. An

Saturday, Jan. 29th...Royal Institution, Albema 3 p.m. Prof. Sidney Colvin, "Th (Lecture II.)

AL OF THE SOCIETY OF ARTS.

No. 1,471. Vol. XXIX.

RIDAY, JANUARY 28, 1881.

cations for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

HOUSE SANITATION.

Council offer the following Medals for iowing the best Sanitary Arrangements es built in the Metropolis, such plans to ited in the Society's Rooms, Adelphi, in 81, and to be sent in on or before 12th 81:—

e Silver Medal for the best sanitary arrange- carried out and in satisfactory working, use let out in tenements to artisans, for weekly rental is paid.

e Silver Medal for the best sanitary nents, in actual working, in a house of the ntal of £40, or less, to about £100 in value.

e Silver Medal for the best sanitary ar- nts, in actual satisfactory working, in a the yearly rental value of £200 and up- o any amount.

houses must be open to the inspection udges, who, in considering their award, guided by the suggestions of plans for rerage, drainage, and water supply, made e Public Health Act, 1875.* The houses re been in actual occupation within the e months, and a Certificate must be given ccupiers, on a printed form, stating the ory working of all the sanitary arrange- uch form to be obtained at the Society of

houses may be old, fitted with modern arrangements, or may be new. They within the metropolitan area of the Board l.

sanitary arrangements must include the s for good water supply, drainage, warm- ventilation of the house, and precautions ainst frost.

medals may be awarded to the occupiers uses, or the lessees, or the owners.

8. The plans must consist of a ground plan and sections, to the scale of not less than one inch to five feet; details of not less than one inch to the foot. The plans may be accompanied by specifi- cations.

9. The names of the architects, surveyors, or sanitary engineers who directed the sanitary arrangements should be given, and Certificates will be awarded to those whose plans obtain the Medals. (By Order)

H. Trueman Wood, Secretary.

* blic Health Act has been revised to 1878, and published jesty's Stationery Office. Price, with plans, three

DOMESTIC ECONOMY.

1. The Council will hold a Third Congress on Domestic Economy, at the Society's Rooms in the Adelphi, London, during the present year.

2. The Council offer Seven Bronze Medals, and Certificates of Merit for Papers (not exceeding 1,000 words), written by Teachers of Public Elementary Schools and Training Colleges, which shall give an account of the best method practised by the teacher, of the teacher's experience, and the result of the teaching, in any one or more of the seven classes of subjects named below.

3. The Education Department, in the Code of 1880 (p. 31), classes the following subjects under Domestic Economy for Girls:—

The First Branch includes—

(a) Clothing and Washing.
(b) The Dwelling—Warming, Cleaning, and Ventilation.
(c) Rules for Health—The Management of the Sick Room, Cottage Income, Expenditure, and Savings.

The Second Branch includes—

(a) Food—Its Composition and its Nutritive Value
(b) Food—Its Functions.
(c) Food—Its Preparation and Culinary Treatment (*i.e.*, Practical Cookery) (§ 24).

The Council have resolved to add the subject of Needlework, which will be exhibited and discussed in the Congress, although it is not classed in the Code as a branch of Domestic Economy.

4. Only one medal will be given to a teacher, but the subjects taught successfully will be inscribed on the one medal and a certificate given.

5. The papers must be sent to the Secretary of the Society of Arts by the 1st May next. Each paper must be enclosed in a sealed envelope, bearing a motto, and must be accompanied by an envelope bearing the same motto, and having within it the writer's name and address.

6. No medals or certificates will be awarded if the papers are not of sufficient merit to deserve them.

(By order)

H. Trueman Wood, Secretary.

EXAMINATIONS IN PRACTICAL MUSIC.

The following report on these examinations has been received from Dr. Hullah:—

The Society of Arts' Examinations in Musical Practice were held at the Society's House and (by the kind permission of Messrs. Chappell) at 50, New Bond-street, on the 10th and 11th inst. In the conduct of these, I was assisted by Mr. W. A. Barrett, Mus. Bac. Oxon., who had kindly taken the sole charge of them on the only occasions on which they had before been held, from both of which I had, unfortunately, been absent.

For these last examinations, 75 names had been entered, the owners of three of which did not present themselves. To the remaining 72, we had the pleasure of awarding 42 certificates of the first class, and 33 of the second. The maximum of marks assigned to the candidates is 100, of which 80 are needed for the attainment of a first-class certificate and 60 for a second. Of the former candidates, two attained the maximum number of marks, 100.

The majority of the candidates (63) were students of the pianoforte (59) or organ (4); (2) of the violin; and (23) vocalists. Of these 11 went in both as vocalists and pianists. Of four of these candidates, who also went in for "Honours," two attained first-class certificates, and one a second-class certificate.

Such a result as this demands a few words of comment, as well as of congratulation both to those who have instituted these and similar examinations as to those who have gone through them successfully. Though only in their second year, these practical examinations are an outcome of the examinations in the theory of music started by the Society of Arts in 1859; and, like those, are an evidence of the progress which musical science and skill have made in this country during the last twenty years. My own experience of them is of long date; and I have no hesitation in saying that they mark an amount of progress in execution, style, ear, reading, and general musical culture no parallel to which, in the same space of time, has been presented in any other age or country.

JOHN HULLAH.

London, Jan. 19, 1881.

INDIAN SECTION.

Friday, January 21st; ANDREW CASSELS, Member of Council, in the chair.

The Chairman, in introducing Sir Richard Temple, said he considered himself fortunate, on this opening night of the Indian Section, in being permitted to introduce so distinguished an Anglo-Indian as Sir Richard Temple. To those who were at all acquainted with India, his name must be as familiar as a household word. Few Englishmen, or natives either, had ever seen so much of India as he had, having traversed it in all directions. He had served the State in different capacities, with advantage to his Government and credit to himself. As he had the honour of being chairman of the Indian Section for the present year, it might not be improper for him to state, on this opening night, that one of the rules of the Society was, that all political topics should be avoided. He did not say this in reference to that evening's discussion particularly, but in reference to any papers which might come before the Society. If it were otherwise, as a member of the Council of India, he could scarcely hold the position he had the honour to occupy.

The address was on—

FOREST CONSERVANCY IN INDIA.

By Sir Richard Temple, Bart., G.C.S.I., C.I.E., D.C.L.

I am about to offer to you, not a lecture, but an oral address in a conversational style, if you will allow me. I must, in the first place, thank those who are present here for coming to this meeting on such a night, and in such inclement weather, but we shall have a larger audience of several thousand members of the Society outside, who will read the report of our proceedings in the *Journal* of the Society. I may say that I esteem it a great honour to be asked to deliver an address before the Society of Arts, remembering as I do, in common with all Englishmen, the great historical and distinguished part which the Society of Arts has played in the educational and industrial history of England during the 19th century. Not only has the Society done much for fine arts, of which we see traces in the room in which we are assembled, but more especially has it done great things in the application of science to all the varied industries of England. It has also done more, probably, than any other Corporation in England, for the advancement of technical education; and in the remarks I shall make to you regarding forests, you will find a signal proof of the mischief which has been wrought, mainly, from the want of technical and professional knowledge on the part of our own countrymen in India regarding forestry. I feel, however, much encouragement in addressing you this evening, when I look back on the names of the great men who have guided the deliberations of this Society, such men as the Duke of Norfolk in the last century, H.R.H. the Duke of Sussex, H.R.H. Prince Albert, and now H.R.H. the Prince of Wales. We have also had and have now on the Council of the Society men whose names are really the property of the nation, such men as Wentworth Dilke, Lubbock, Leighton, and Galton. But more especially we have had on the Council many men who have contributed much to develop the industries of India in particular, such men as Cole, Sykes, Birdwood, Alcock, Siemens, Cunliffe-Owen, and Brassey. Well then, looking to these names of men, some departed, and others still present among us, we ought all of us, those who speak and those who listen, to feel the responsibility which attaches to all of us in assisting in the deliberations and proceedings of such a Society as the Society of Arts. Amongst its many educational and scientific operations, arboriculture was one of the earliest. As a remarkable instance, I may remind you that it is now nearly 130 years since this Society began to pay attention to forestry, an attention which, as you perceive, remains undiminished up to the present moment. It was soon after 1760, as you will perceive from the history of London, written by Charles Knight, and Davenport's history of our Society, that gold and silver medals, presented by this Society for planting firs and cedars, were won by such distinguished persons as the Dukes of Bedford and Beaufort,

l Paget, Earls Winterton, Ossory, Mansfield, Wilton, the Bishop of Llandaff, and the quis of Tichfield. There were also men in days whose names have been handed down in history of British agriculture as well as iculture, namely, Curwen, of Windermere, e and John Hutton, of Yorkshire, and Buck- These men originally showed what could be in the way of tree plantation in Great Britain, t is to be hoped that they may prove to be ncestors of a long line of Englishmen, who, generation to generation, will distinguish selves in arboriculture in all parts of the ish Empire throughought the world.

rom this brief preface, which I hope will not uninteresting to members of the Society at present time, I will pass straight to the ct of the evening, namely, "Forest Conncy in British India." India, of course, is he only country in which questions regard- forestry are becoming prominent. The ief which has been wrought by the destruc- of forests is patent on the face of Europe. destructive floods which have occurred in parts of France, are directly due to the dation of the Swiss hills. Similar questions eing raised in South Africa, and we hear even njury being feared in the United States of rica. In India, the destruction has been vast. traditions of the forests in India show how the was once clothed with sylvan and other vegeta- but every time a city had to be built or a e erected, or in modern times a railway to be tructed or barracks to be built, there has a ruthless destruction of forests. Of course sts were made for the use of man, but may be so cut as to leave something for re- luction. Instead of that "they have been swept y as clean as if they had been shaven by a razor" speak figuratively. Well, notwithstanding this ruction, still forests remain, though they can ardly said to be more than the remnants of t once were the forests of India. You will say, haps, why did not the Government and its officers p this devastation. They did not stop it, simply use they were none of them properly instructed matters regarding forests. Such ignorance is to be wondered at, considering the ignorance ch has prevailed in Europe and in other parts he world. I know that 20 or 30 years ago, n we were young men in India, we, none of us, d of any principles regarding the forest con- ancy. The consequence was that forests, being ote and difficult of access, not easy to visit or nderstand, and we ourselves being ignorant of ything regarding forestry, we paid no attention tever to the subject, and consequently, when- wood was wanted, forests were cut down by ons who had nothing to do except to make as h as they could at the present moment, without rd to the future, and so forests have been royed in the most thoughtless and merciless ner. Still, there are great mountain ranges, instance, the Western Ghauts, which form a ntainous wall on the western coast; the ern Ghauts, which form a similar range, although so regular, on the eastern coast; two great es, the Sathpura and Vindhyas, which unite in direction of Bengal, and form one broad moun- ous region; there are the mountain ranges on the east of Bengal, separating Bengal from Burmah; and, lastly, there is the great Himalaya range itself. I do not now speak of the mountain range on the west of the Indus, because that was originally a region mainly destitute of vegetation, and whatever vegetation there was has long been swept away by the action of man; so that really the great range which separates India from Afghanistan counts for nothing, in the language of forestry. The ranges with which forestry in India has to do are the Western Ghauts, the Eastern Ghauts, the Sathpuras and Vindhyas, the Eastern Bengal ranges, and the mighty Himalayas.

In these mountain ranges, there are numerous kinds of trees, which constitute a forest flora in themselves. It is quite impossible for me, within the time at our disposal, to even enumerate, much less describe to you, the various kinds of trees which exist in the Indian forests; still I may mention, by way of recapitulation, some of the most striking and interesting trees which we have. The trees of India must be divided mainly into two main divisions, the Himalayan division, and the plain division, which latter comprises the whole of India proper.

Now, the Himalayan trees are allied mainly to the trees of Europe and other temperate regions. The *coniferæ*, including the great genera of firs, pines, and the like, are found all over the Himalayas. Amongst them the queen is the cedar. Nowhere in the world are such fine cedar forests to be seen as are in the Himalayas. You have some idea, in this country, from the lawns of our principal country seats, of what beautiful shape and colour the foliage of the cedar is; then imagine trees much grander, much finer in trunk, and branch, and foliage, with a background of everlasting snow; imagine them situated in the midst of rugged situations, and with the most glorious surroundings. And there is a further interest attaching to them, from the way in which they are felled, and the mode in which the logs, when felled, are transported to market. The value of a cedar forest depends on its situation. If the trees stand upon precipitous sites, overhanging rivers, they are felled to great advantage. The tree is felled, and the log is shot down the precipice into the roaring, cataract-like, torrent of the river. The river itself acts as a carrier, and whirls log after log down to the plains. And as the river, laden with all this freight of cedar logs, emerges from the Himalayas, skilful native swimmers are stationed on the bank, and dart forth and catch the logs as they descend the stream.

Similar remarks apply to the *Pinus longifolia*, which is, next after the cedar, the most valuable timber tree in the Himalayas. In fact, in Northern India, most of the great public buildings of the British Government, and most of the palaces of the native princes, are largely constructed with the timber of cedar and pine. As a matter of interest, I should not omit to mention the cypress. But the cypress of the Himalayas is not the funereal sort of tree which you read of, or see depicted, as constituting a great feature in the cemeteries and burial-grounds of the Levant or Constantinople, but is a truly magnificent tree, growing, too, in the very midst of the limestone formations. There appear to be certain chemical elements in the limestone which

favour the growth of the tree, and the consequence is, that the cypress may be seen fringing limestone precipices, where you would suppose that no vegetation could possibly grow—in places, indeed, where the only vegetation perceptible consists of these cypress trees, growing, as it were, out of the very crevices of the rocks. But, as regards funereal aspect, the most mournful looking tree in the Himalayas is the fir, which is named the *Abies Smithiana*. That, indeed, has long, pendant foliage, of a very weeping, mournful appearance, but still impressive and picturesque, especially when combined with other foliage, and more particularly, perhaps, when it is adorned by the beautiful golden red of the Virginia creeper. Imagine the bright scarlet leaves of the creeper winding about amongst the dark coloured, mournful-looking foliage of the fir, and you have a delightful picture.

Then another tree, most beautiful in the Himalayas, is the yew. It does not grow there singly, as it does in this country, but in a few spots among the Himalayas it grows in a dense forest, limited in size, but extremely thick; and nothing can equal, from an artistic point of view, the beautiful forms of these dependent branches and the foliage of these yews. The beautiful lines of Wordsworth are applicable to these yew forests—

"Joined in one solemn and capacious grove
Huge trunks, and each particular trunk a growth
Of intertwisted fibres serpentine;
Nor uninformed with phantasy, and looks
That threaten the profane—a pillared shade.
Upon whose grassless floor of red brown hue
By sheddings from the pining umbrage tinged
Perennially . . . . Ghostly shapes
May meet at noon-tide."

Lastly, I should mention the juniper. This tree is extremely fine in the Himalayas; and when I mentioned to you just now that the trans-Indus range, near Afghanistan, was almost treeless, I ought to have made one exception in favour of the juniper. We hear now much of the Bolan Pass, and of Quettah, but the only valuable timber you have near Quettah consists of juniper forests, which grow near the summits of the limestone formations, 10,000 or 12,000 feet above the sea, which overlook those valleys, now so interesting to us from a political point of view.

Then, passing from this great natural order of *coniferæ*, we come to the other trees which are very familiar to us all in this country, the ilex, the oak, and the walnut, which are found in great abundance at Simla, where, as you know, is the residence of the Governor-General and his Council in the summer months. Near Simla, there grows the holly. In that locality it is not a shrub, as it is in this country, but a very fine tree of 50 to 60 feet high. I ought also to mention the plane tree. The plane tree is a great glory and ornament of the happy and world-wide celebrated valley of Cashmere. The scenes of the poem, Lalla Rookh, were laid in the midst of plane groves. Plane trees formed the ornament of the gardens of the great Mogul on the margin of the beautiful lake of Cashmere. The famous wooded island which stands in the midst of the lake is adorned with plane trees; in fact, in Cashmere, the plane is the crown and glory of the valley. In the eastern part of Himalayas, near Darjeeling, we have the maple; also the magnolia, which is brilliant with masses of white flower, so that it looks in the midst of summer as if it were sprinkled wi fresh snow. The laurel grows there to a gr height, not like the shrub as we see it here, but a great tree 70 to 80 feet high. The tree fern probably the most graceful member of the vegetal kingdom to be seen in the world—the tree fern the eastern Himalayas. No word-painting of mi can give you any idea of the minutely grac character of the foliage of the tree, especially, t as it is generally seen with the distant backgrou of the highest snow mountains in the world.

Before we leave the Himalayas, I must say word about the rhododendrons. The discovery the Himalayan rhododendrons is mainly due to Joseph Hooker, the distinguished director of establishment at Kew. With great toil and ha ship, and with much exertion, he discovered a brought to England specimens of most of the fin species of rhododendrons. The tree does not gr there in shrubs as you see in this country, b attains a height of 20 to 30 feet. Its flowers, se in its native habitat, are almost as large as man's head. The leaves found on the trees th are 12 to 13 inches long. The branches a the trunk are permeated with a sort of r colouring matter, so that the whole of the tr seems ready to burst out with red; anything mo magnificent than the appearance of this tree ca not be imagined. It is generally found in t midst of very rocky scenery; it flowers with gre abundance, at altitudes of 12,000 to 13,000 fe and that generally at a season in May and Ju when the long winter of that region has hard passed away, so that the rich flowers are fad and bleached in a day or two after blooming b the masses of fog and driving rain, and som times even of sleet, to which they are exposed.

So much, then, for the trees of the Himalay I regret that time does not admit of my dilati more fully upon them.

I must pass rapidly on to the trees of plains. The first I shall mention of course is teak, or *Tectona grandis*, which is the quee trees in the plains, just as the cedar is the q of trees in the mountains. It is said enthusiastic foresters to possess every v of which wood is capable. It is good un ground, it is good on the water, it is in the burning sun, it is good everywhere, under all circumstances. It carves well; light, it is durable; it will stand wet, an seldom affected even by insects. It is used, as know, largely by the British Admiralty. appearance always attracts the eye of the obser on account of the arrowy manner in which it sho up. Even the young tree, which is hardly foot or two above the ground, always looks an infant giant, or a young Hercules, amongst tre by the striking manner in which it rises from th ground and seems to aspire upwards.

Then there is sāl, or *Shorea robusta*, which i commonly called the iron-hearted Sāl, on accou of the great strength and durability of the wood but it has not nearly so many virtues as the tea especially in that it is so very heavy. But i appearance is very fine, with a tall, straight trun and branching head. It is to be found in t greatest perfection near the source of t Nerbudda, near the point where the two ranges the Sathpuras and Vindhyas unite. Next I shou

he two finest kinds of the natural order *minalia*; the *arjuna*, or anjun, is remark- ıe beauty of its trunk, which can only be a great marble pillar. The trunk is abso- ;e, bright, and smooth, generally growing ks, on the margin of streams, and in a very te. The trees I have hitherto been grow in the cool, but this tree the midst of the greatest heat. The of terminalia is the *Pentaptera tomentosa*, hat is the very opposite in appearance. ! having a white and smooth trunk, it ck and rough trunk, and, as the two ı grow in juxtaposition, the effect is as u saw a pillar of smooth white marble lar of black rough stone placed close Then there is the *Pterocarpus marsupium*, , also a tree with a black-looking bark. listinction to them, I may mention the *Boswellia thurifera*, commonly called the ıse-tree. I have just mentioned the which has a rough, black bark, and, in to that, I mention the salai. Instead bark, it has white bark; instead of a runk, it has a winding, bending, strag- nk, with branches thrown out in a kind , wayward manner. The salai, in sum- , may be called the ghost which haunts ts of India.

es which I have just mentioned grow always ountain ranges of British India, as contra- ished from the Himalayas; but I must now some of those which grow in the plains.

of all there is the babul, or *Acacia arabica*. the one tree which is universal in India, used almost for every purpose which is in the daily lives of the natives. Then the mango-tree, which is known, of course, country on account of its fruit, and which es a staple article of food to the mass of ple. But it is also valuable for timber. It d in fine avenues on the sides of roads, and in groves near to the Hindoo temples. Then the sundar tree. You have often heard of nderbunds, that great, semi-marine forest grows on the low, sandy region near the of the Ganges. They are called the Sunder- but that name is really derived from the which is the principal tree in that part of est, extending for thousands of square miles. t forest, the most remarkable tree is the from which all the country boats of Bengal le. As you may have heard, the river traffic m Bengal is, perhaps, the most extensive f the kind in the world. The network of navigated by hundreds of thousands of The boats there are to the inhabitants what l wagons are to the inhabitants of other ı; and all these countless boats are made sundar tree, which grows in the forest I ribed, near the mouth of the Ganges.

re have the different kinds of fig tree, or here is, first of all, the ordinary *Ficus*, known popularly throughout the world as n tree. That is the tree under the shades whole regiments are occasionally en- It is the tree which you have read of ., and in the works of many modern he beauty of the tree consists in the ı which it throws down tendrils from its branches, which take root in the earth and form fresh trunks; so that a finely-developed banyan tree looks like the interior of a great Gothic structure. The tree has its colonnade, its arches, its aisles, its naves, and its transepts, and its roof consists of the densest foliage, so that the perspective view, taken in the interior of one of these great banyan trees, is, perhaps, the finest sylvan subject which the artist can possibly have for his brush or his pencil. Then there is the pipal, which is called *Ficus religiosa*, which is to be found near every Hindoo temple. It is remarkable for the manner in which its branches entwine themselves amidst the masonry. You know the old song—

> "Creeping where no life is seen,
> A rare old plant is the ivy green."

Similar to this is the *Ficus religiosa*. It is always to be found in the midst of ruins; in fact, it is one of the causes of old buildings becoming ruins, for once it insinuates itself into the building, it gradually works its branches and its tendrils through all the interstices of the masonry, until possibly the whole structure is embraced in its fatal grasp. The building then becomes like a human being seized by a boa constrictor, or like the Laocoon encircled in the folds of the Python. Lastly, there is the *Ficus elastica*, or india-rubber tree, which many ardent foresters believe will, ere long, more than rival the india-rubber trees of South America.

Then there is the bamboo, the beautiful feathery bamboo, which affords the means of constructing almost all the huts, cottages, and villages of the inhabitants of Bengal. But, besides what may be called the domesticated bamboo, there is the wild bamboo of the forests of Central India, which is truely a lovely tree. A single shoot of the bamboo has been shown at an exhibition, to the height of 80 or 90 feet, with a little flag at the top. These bamboos, too, generally overhang the pools of rivers, so that taking these great, beautiful, graceful bamboos, bending over the stream, and the reflection in the stream—together forming almost an arch in appearance—a more picturesque object cannot possibly be imagined.

Lastly (I hope I have not wearied you by describing these various trees) we come to the palm. Now, the first of the palms to be mentioned is the date-palm, that is the kind which is known to poetry as the feathery palm. Our Indian date-palms are, no doubt, not so fine as those of the valley of the Nile, and on the banks of the Tigris and Euphrates, which run into the Persian Gulf. Still, next after these, our Indian palms are the finest in the world. Sometimes they grow singly, but often they are to be found in great clusters, and often in long, straight avenues. Then we have the Palmyra palm, with great fan-like leaves, just like a human hand stretched out. It is, perhaps, more noxious than beneficial, for from it some of the strongest spirits in India are distilled. Then, lastly, I shall finish my mention of trees by describing the cocoa-nut. Now, the cocoa-nut, probably, taking it all in all, is the most useful tree of all the trees in India, for it is commonly said—and truly said—that the cocoa-nut will provide everything which a human being can require. It will give him the most nutritious food, slightly oleaginous, perhaps, but

still very strengthening; it will also give him the sweetest and most delicious drink; it will afford him everything that he can require for clothing; it will furnish him with roofing for his house; and it will give him not only the roofing, but the rafters. It will supply timber for the pillars upon which the edifice rests, and it will also give him the best material for rope; so that there is not a single use which man can require in the vegetable world which is not supplied by the cocoa-nut, and the cocoa-nut of India is second only to that of Ceylon, if, indeed, it is second. It grows in the greatest abundance all along the Malabar coast. There the cocoa-nut tree constitutes a little freehold—a little property—for actually the land revenue in some districts is based upon the cocoanut trees. That is to say, a man and his family get their living and pay their revenue out of a few cocoa-nut trees, so valuable is the tree.

Now, I wish I could dwell much longer on all these beautiful, interesting, and useful kinds of trees in India. I have hoped to induce you to feel an affectionate interest in them, to love the forests, so that they may live in your imaginations as they live in mine. But, from this brief summary of the subject, I must pass on to the question of how all this vast national wealth should be preserved.

Before doing so, I must first say something as to the reasons why the trees are valuable. They are valuable you will find, I think, for two main purposes, one economic, and the other climatic, and I will touch upon each of these subjects separately.

First, I will allude to the economic purposes. Now, the preservation of forests is desirable for the purpose of conserving the great wealth with which nature has endowed India for the use of men. There are no less than 37,000,000 of inhabited houses in British India, and I need not say that for every one of those houses wood is required. The majority of these 37,000,000 houses are constructed mainly of wood, so you can imagine from that what an enormous demand there must be in the vast British Indian population of 200,000,000 persons for timber for house building alone; besides, there are 40,000,000 of inhabitants of native States. Again, most of the domestic implements of the people are made of wood. No doubt, implements of various metals are being substituted for implements of wood, but, still, wood enters more largely into the consumption of the Indian population than that of most populations in the world for domestic implements. Among agricultural implements, take ploughs for instance, there is no accurate return of the number of ploughs in British India, but the best returns show at least 8,000,000 of ploughs. That, probably, is much below the mark. If you consider that there are not less than half a million villages, if there are 10 ploughs to a village, that would give 5,000,000; if there are 20 ploughs to a village, that would give 10,000,000; and if, which is much more likely, there are 30 ploughs to a village, that would give, perhaps, 15,000,000. From these facts you can judge what an enormous demand there is for wood, even for implements of agriculture. Then there are the carts. It is almost impossible to give any idea of the number of carts. There is no proper return of them, I am sorry to say, but they must be counted also by many millions; and as for the boats, in some parts of the empire they are also to be numbered by hundreds of thousands. Then, also, there is the consumption of fuel. Now, to meet the demand for all the purposes I have been hitherto mentioning, wood is somehow found from the forests; but, for fuel, there is, in most parts of India, an absolute want of wood, and the consequence is that the people use for fuel the cow-dung which ought to be used for manure. You hear very much in India of the gradual exhaustion of the soil. I hope (and that is all we can say) that the exhaustion is very gradual. It certainly does appear, from many proofs, to be very slow. But, at all events, the gradual exhaustion of soil is to be feared, unless the people can have some better means than they have at present for obtaining manure. At present, much of the natural manure of the country is being used for burning, and you can imagine from that what a grave disadvantage is inflicted upon a country from the want of the conservancy of the forests. In fact, the agriculture of the country is suffering greatly from this cause. So much for economic purposes.

You will readily perceive how numerous and extensive the markets must be for timber and fuel, how difficult it is to keep them adequately supplied, and yet how fatal to the country it would be if they were to become depleted. Without a system of State conservancy, the forests would shrink and shrink, while the population increases; materials in wood and timber would become scarcer and scarcer; the price of fuel would rise, so as to press heavily upon the poorer classes.

But there are other purposes, namely, the climatic. There are many people who think the droughts with which India is periodically visited arise from the destruction of forests. Too much, perhaps, must not be made of that cause. There is a certain amount of evaporation from the Indian Ocean, there are certain masses of clouds, and they must condense somewhere, so I do not suppose the total rainfall of the continent of India can possibly be effected by forests; but the distribution of the rainfall is probably very much affected. The clouds pass over the dry plains, and go straight on to the mountains. They arise in the Indian Ocean; the first obstruction they meet with is from the wall of hills which I have described to you along the western coast, but, passing over this wall of hills, they sweep over the dry plains of India, and then they meet with the Sathpura and Vindhyas ranges which I have described. They are stopped there; they condense on these ranges, and then cause torrents of rushing streams to arise and swell the rivers. Thus the clouds return back to the plains in the shape of floods, and sweep away the railway viaducts, and carry roadways to destruction, and so effect numerous damages. Now, a great deal of these floods might have been avoided, had the clouds been arrested in their course over the plains, and this arresting can only be brought about, in the opinion of the best judges, by the preservation of the forests. If the forests exist, a cool surface is presented to the clouds, which causes them to stop and condense into rain, and drop fatness on the earth. If there are no forests, the clouds pass

in the upper stratum of the air, until they are ɔped by the hills.

'he same description applies to Bengal; the ours arise from the Bay of Bengal, and are pt over the plains of Bengal, and are stopped he great mountain ranges which divide Bengal a Burmah; or, again, they sweep over the er valley of the Ganges and Jumna, until they checked by the Himalaya. Time does not nit of my properly entering into this meteoro- ical subject, but you will see, from these main ts, how very probable it is that the existence or n-existence of forests may greatly affect the tribution of the rainfall. If there are no forests, e probability is that at one time there will be ughts, and at another time immoderate rains, a period of floods almost always follows, ording to past experience, a period of drought. is it is to the forests we must partly look for ng blessed with the early and the latter rains lne season.

pass then to another point with regard to natic influences, viz., the retention of moisture. re is no doubt that forests produce this result y considerably. If the vegetation is destroyed, streams run dry unseasonably, and the wells e but a scanty supply of water. If the vegeta- n is preserved, the excessive moisture of the ny season is stored by a natural process, for the of man during the dry season. More especially is s important in those parts of India where canals re been constructed. Some of the canals of India drawn from rivers which have their source in Himalayas, in the perpetual snow, and for m forests are not of great importance. But ny of the canals of India are drawn from rivers ich rise in the mountain ranges of India itself, d if these mountain ranges are denuded of vege- tion, those streams which feed these precious nals will all run dry in seasons of drought, so at, if we are to maintain our great canal system full efficiency, we must preserve the forests near e sources of those rivers.

One more point with reference to climatic con- derations, and that is the preservation of pastur- ge. The cattle in India have too much food at me seasons, and too little food at other seasons, d the consequence is that the animals, which ve been suffering from depletion or inanition ring the dry months, are apt to surfeit them- lves as soon as the vegetation bursts forth into e upon the commencement of the annual rains. w, the great object is, by preserving forests, to serve the grass during the dry seasons. If re is a certain amount of vegetation, e grass is sheltered from the burning sun, and ll thrive and afford fodder for cattle, whereas, all the vegetation is swept away, grass will not ive. For that reason, many experienced men ink more ought to be done in the plains of India r the establishment of what are called communal rests, and that every village, or cluster, or circle villages, should be induced or compelled to com- e for the establishment of communal forests, ich shall afford a certain amount of timber and l, and shall also preserve the grass for the cattle. These are the main reasons, in brief, why the servation of forests is a matter of such vital portance and national concern in India.

I then come to the measures to be taken for pre- serving these forests. I have sorrowfully admitted to you the neglect on this subject, which has pre- vailed in former years. Nobody is more zealous than I am in vindicating the character and con- duct of our Government and officers in India, but I must admit that in respect of the preservation of forests, we have not, until within the last 20 years, done as much as it behoved us to do. I attribute that not to any wilful neglect, but simply to the fact which I stated at the outset of my address, namely, a want of knowledge. It is the deficiency of technical education on this subject which has caused the partial destruc- tion of these great sources of national wealth— a wealth too, which, as you see, is essential to the well-being of the country. But, of late, we have been mending our ways in that respect, and we have established a very highly organised depart- ment of forestry. We now have a large staff of trained forest officers—I wish I could add that they had been trained in this country. You may have seen lately that there is a project for estab- lishing a forest school in England, in connection with the forest of Epping; hitherto, however, our English forest officers have been trained, not in their native country, but in France and Germany; and we must acknowledge the great debt we owe to our gallant neighbours, the French, for the ex- cellent forest school of Nancy, which has given us many English officers for the benefit of the Indian forests. Still, I do not see why forestry should not be taught in England as well as anywhere else. You do not require a very large or extensive wild forest, in order to learn the principles of forestry. Any of the numerous woods and covers which adorn the undulating valleys of England would do perfectly well for instructing Englishmen in the art of forestry, to say nothing of the woods which may be found in Scotland or Wales. But, at all events, it matters not so much where the men are instructed, as that they should be well instructed somewhere; and I am happy to state that we have now a Forest Department of India which, in respect of scientific, technical, and practical knowledge, is second to no similar depart- ment in the world.

Now, you will ask, what exactly does this great department do? In the first place, the remaining forests—I must call them remaining forests, because you see how the ancient forests of the country have been destroyed—are divided into two great cate- gories. They are divided by law (for the matter has received careful attention from the Legislature) into two classes; firstly, reserves, or the forests which are absolutely guarded; and, secondly, the protected forests, which are imperfectly guarded and preserved. To give you any idea of the extent of these forests, I must mention to you the area in square miles, and you will find that at first sight the area does present a respectable aggregate or total. In the Punjab there are now 4,000 square miles; in the North-West Provinces, 3,000; in Bengal, 9,000; in Assam, 7,000; in the Central Provinces, comprising the Sathpura and Vindhya ranges, which I have mentioned several times, 20,000; in Berar, 5,000; in several miscel- laneous districts, 1,000; in British Burmah, 2,000; which are, probably, the best forests in the empire. All these make up, for the Bengal Presidency, a total of 51,000 square miles. To this you must

add 13,000 square miles for Bombay, and 5,000 for Madras, which make up a grand total of 69,000 square miles, or, say in round numbers, 70,000. This sum total will, ere long, be augmented, because there are many thousand square miles yet to be marked off in British Burmah, and, I believe, there are some thousands of square miles also to be marked off in Southern India, within the limits of the Madras Presidency, so that, I dare say, within a few years, we shall have not less than 100,000 square miles of forest in India, which, I hope, is a figure worthy of being mentioned before a distinguished Society like this. But it were vain, if I were to lead you to believe that the whole of this area, of 70,000 square miles, is properly protected; I am afraid that the greater portion of it is imperfectly protected; but, still, I think that nearly half is really well preserved; and I see that the Famine Commission, in the very careful report they have recently made on the resources of India, say that 25,000 square miles are thoroughly guarded and preserved; but at all events, the whole of this great area is, more or less, under some protection and supervision.

The Forest Department, as above described, manages directly all the forests technically described by law as "reserved," and supervises the management by the ordinary civil officers of the forests technically described as "protected." From these forests, the markets for timber and fuel are largely supplied. The proceeds for all British India amount to about three-quarters of a million sterling annually, and the expenses to half a million. Thus, the department defrays all the charges for the conservancy, and yields a small revenue to the State. Many articles of wild forest produce, such as gall-nut and sandal-wood, are sent to the great marts for exportation abroad.

Besides the area of forests, as above set forth, there are extensive areas of jungle of equal, probably more than equal extent, left in the hands of the people, under the terms of the Land Revenue Settlement. From these jungles most of the local wants of the country, as above mentioned, are supplied.

The first-class timber markets are, however, supplied from the "reserved" forests, and the second-class timber markets from the "protected." From both kinds of forests excellent fuel is obtained.

The railways were at first worked with wood fuel; but coal is largely used, now that the mines are being opened. With a good conservancy system, however, there ought not to be any apprehension on account of wood being consumed by the railways. For forests could, in many places, be formed all along the lines of railway, and would supply fuel, while improving the country.

Then the question arises as to what does this preservation and guarding consist of, and to what intents and purposes are the forests protected? Well, now, they are first protected as to the matter of wood-cutting. The forests are not treated by the Government as if it were the dog in the manger. Timber is intended for the use of man, and the object is not to preserve the trees for ornament, but for use. As soon as a tree has attained its utmost development, and grown to its full height, it is fit to be cut, and ought to be cut; and in many cases trees grow so thickly together that thinning of them is a positive benefit to the vegetation of the forest. So, then, the restrictions upon wood-cutting are not made absolute, but are instituted in order to insure that a certain number of trees shall always be left for reproduction.

The next point is to regulate the practice of what is called "rab." Now, rab means this—that the new shoots and sprigs of the trees are burnt, and their ashes are used for manure. You will readily understand that such ashes contain many of those chemical constituents which are needed for manure, especially where much of the natural manure of the country, viz., the cow-dung, has been used for fuel. Now, this practice of cutting the sprigs of trees, and burning them for ashes for manure, is a practice which, if not regulated, will cause great damage to the forests; but, nevertheless, to a certain extent it is necessary.

Then another matter is the prevention of the jungle fires. These jungle fires are partly accidental and partly intentional. When they are accidental they present some of the most magnificent spectacles you can possibly imagine. I, myself, and many other people in India, have been sometimes out at night in the midst of these fires, and you then see some of the grandest, if not, perhaps, the most alarming sights you ever witnessed. The way in which the devouring element rushes over the country, travelling sometimes at the rate of several miles an hour—the wild animals fleeing before it in terror, the native inhabitants of the forests sometimes even being caught in the flames and being burned to death, poor men, and occasionally even mounted Europeans having to gallop away to escape from the vast rushing conflagration—all these things constitute a wonderful sight. Then, the manner in which the trunks of the trees form as it were pillars of fire, or the clumps of bamboos rattling and crackling just like the roll of musketry, and sometimes the sound of the falling forest, and the roar of the flames is not unlike the resonances of artillery or the thunder of Heaven. Again, the manner in which some of the trees smoulder is quite wonderful. Stories are told of trees sometimes burning for many months together, and one I heard of, or rather read of, as having burned for three years consecutively. First, the trunk smouldered, then the fire got to the roots, and gradually burned through the radicles for months and months together.

Now, you will readily imagine what mischief is caused by such conflagrations as these spreading over many square miles. Yet the cause of the accident is often trifling, a wayfarer lighting his pipe, a labourer cooking his dinner (after the Oriental fashion) in the open air. With a system of conservancy, these accidents are minimised, or almost prevented altogether. Without such a system, they become terribly frequent.

But the fires are also intentional, and are lighted up every year to insure the plentiful growth of fresh green grass for the grazing of the cattle. Of course, to some extent, that is permissable, and the hills at the back of Bombay, in the months of April and May, are lighted up at night with a magnificent illumination. In fact, so popular is the practice, that, whenever there is any political disturbance anticipated, the natives say "the fire will be out on the hills," and

from that we understand there is going to be a disturbance.

There is another way in which the burning of the fires are intentional, viz., this, there are many wild hill tribes who carry on their agriculture, not by means of ploughing, but by means of burning fires, and letting the ashes lie on the ground until the rains come. Then the rains descend on the virgin soil, which, fertilised by the ashes of the burnt forest, produces abundant crops without any further labour whatever. This, of course, is an utterly barbarous practice, and it arises only from the ignorance of the people. No doubt the localities are often very steep, and it is not so easy to plough as it would be in the plains, with these very sharp gradients. Nevertheless, the practice arises from ignorance on the part of the people and from their want of agricultural capital. The object of the British Government is to wean these poor people from the barbarous practice, to reclaim them from habits of agricultural savagery, and to make small advances of money to them for purchasing ploughs and plough cattle, and so teach them to depend on settled agriculture rather than on these wasteful destructive fires.

Then, another purpose to which the forest conservancy is directed is the preservation of the grazing. If the cattle are allowed to wander unchecked in the jungle, they will eat a little and destroy very much; that is to say, they will tread down and trample and destroy uselessly ten times as much as they consume for food. The object, therefore, is to restrict the grazing by means of a sort of block system, that is to say, to allow the cattle to graze in certain blocks or areas of forest range, and to prevent them grazing in others. The block or area is protected from grazing, and as soon as its vegetation has grown up, then the cattle may be admitted to graze safely. Of course cattle must have pasturage, and the object should be to provide pasturage ground sufficient for their real consumption, but to prevent them from needlessly destroying the vegetation.

It is this useless destruction of the pasturage, from want of conservancy, that renders the country so destitute of fodder whenever drought occurs. It is essential to husband the spontaneous fodder of the country, as a resource to be available in time of need.

In all these matters you may readily perceive that the question arises of the restriction of the rights of the people, and there is, to some extent, a slight contest always going on between the forest officers and the ordinary civil officers of the Government. The forest officers, of course, are zealous for preserving the forests, and the civil officers naturally protect the rights of the people. The object is to maintain a judicious compromise. The people who sparsely inhabit the forests have been accustomed to cut, burn, and destroy somewhat recklessly, and they cannot speedily be reclaimed from these evil habits. This can only be done by degrees. But while, on the one hand, their reasonable rights are protected, on the other hand, they must not be allowed to destroy forests altogether, otherwise there will be no *corpus*, as the lawyers say, on which any rights are to be founded; the whole property of the country will be destroyed, the natural wealth will vanish, and there will be nothing for anybody to have rights in at all. So that, in a judicious gradual and conciliatory manner, forests must be preserved, while a fair and equitable consideration is given to the well-established customs of the country, notwithstanding that these customs are, to some extent, objectionable.

The "reserved" and "protected" forests, technically described above, have been adjudicated, after inquiry, to be the property of the Government. Full provision is made by law for determining disputes between the people and the Government authorities regarding the ownership of the forests, and the boundaries are defined of the jungles which belong to the State and to the natives respectively. An ample quantity of jungle has everywhere been marked off as belonging to the people, and within that area no restrictions are placed upon the natives. The restrictions exist only in those forests which from time immemorial have belonged to Government under native dynasties as well as under British rule. Within some of the Government forests, especially in the technically "protected" forests, subordinate rights are found to pertain to the natives, under the Government, as lord of the manor. These rights are also investigated under the law, and defined.

Thus no just cause of complaint whatever is allowed to exist on the part of the people against the forest system, though there is no disguising the fact that many would desire to cut down the State forests at their will for immediate gain, without any care for the future.

There are certain things which in all countries are recognised as pertaining to the business of the State, or rather public authority, such as the coinage, the post-office, the electric telegraph, besides the important departments of sanitation, education, and the like. In some great branches, the State, if it does not directly undertake the management, does yet interfere considerably, notably in the case of railways. Now, in India at least, forest conservancy is to be classed in this category. There are many things in which private enterprise is better than State action, but forest conservancy is not one of those. The saddest experience has shown that if forests are left to private action unrestricted, they will be destroyed. Hundreds of tracts are to be seen in India, now bare and barren, where forests and vegetation once abounded, and might again abound under a proper system of conservancy. Hundreds more of tracts exist where the denudation has occurred within the present generation. Sadder still, in many places the mischief is irreparable, because the soil has been, after the loss of its vegetation, washed away by the action of rain. If left to themselves, the people would work out the forests to destruction, just as a spendthrift lives on his capital—in homely phrase, they would kill the goose which lays the precious eggs. The true object of conservancy is to preserve the forests as an inestimably valuable capital with which nature has endowed us, and to draw from these, for the use of the people, interest, in the shape of timber fuel and other produce judiciously cut or felled, and grass or fodder grazed according to a scientific system. It is this which is now being done effectually, though but too tardily, in India. If forests are worked without any State supervision, they are exhausted, and

nothing is left for reproduction. If they are worked by the State, then some trees are always left to keep up the vegetation.

I have now touched briefly, and I am afraid imperfectly, according to the short time at our disposal, on the nature of the forests, on their value, climatic and economic, upon the means which should be provided by the Legislature and the executive for preserving them, and the objects to which that preservation is directed. Before I resume my seat, and invite discussion on these very interesting and important topics, I would desire to re-call to the grateful recollection of patriotic Englishmen, the names of some of our countrymen who have most distinguished themselves in respect of forest conservancy in India, but I must first mention two distinguished Germans. It has always been the pride of the Indian Government to attract to its service eminent men of other nations, and amongst its best servants is Dr. Dietrich Brandis, who has done more for forest conservancy than any other person who could be named, for not only has he organised a system which is scientific and practical, but he has also contributed much to botanical science in India, and is the author of an excellent work, entitled "The Forest Flora." Next after him I would mention his distinguished countryman, Dr. Schlich, who, for a long time, was Conservator of the forests of Bengal and Assam. After them I would mention Dr. Cleghorn, of Madras, who I am happy to see present amongst us this evening. Then there is Dr. Stewart, the late Dr. Dalzell, of Bombay, Mr. Beddome, and Maj. Campbell Walker, in Madras; Col. Pearson and Capt. Forsyth, of the Central Provinces. Capt. Forsyth was one of the men who worked so hard in the forests, that I may say he almost laid down his life for their sake, and has left, as the memorial of his labours, one of the most charming books on forestry that has ever been written. In Burmah, the forest department has been well represented by Messrs. Seaton and Ribbentrop. Then I may mention the two other zealous officers who are now carrying on forest conservancy under great difficulty in the Bombay Presidency. These are Mr. Shuttleworth and Col. Peyton, and lastly I would particularly mention a member of the Covenanted Civil Service, Mr. Baden Powell, in the Punjaub. These are the men who have struggled to preserve our forests through evil report and good report, with a considerable measure of success, and who have, from their sense of public duty, from their regard to the welfare of India, and from their love of the forests, borne much hardship, have endured many toils, and have risked their health, and some even have lost their lives in the service of the forests of India.

It is a cause of thankfulness that scientific and practical forestry is taking a hold upon the public mind in India. The European civil officers of the Government are beginning to understand the subject, and to co-operate with the regular forest officers. Schools of forestry for the natives are being established.

In conclusion, this subject, which I have, I am afraid, imperfectly treated in the brief space of an hour, is worthy the best attention of such a body as the Society of Arts. This Society has influenced Englishmen in many directions, and I venture to say that there are few directions in which the influence of so learned, influential, and practical a Society as this can be more beneficially exercised than in furthering the interests of forest conservancy in India, which is the greatest of the dependencies of England.

DISCUSSION.

Dr. Cleghorn said it had given him great pleasure to hear Sir R. Temple's description of the forests of India, and of the improved management which now existed. In December, 1856, he was called upon to begin at the very beginning, as the first forest officer appointed in Madras; his friend, Dr. Brandis, began his duties in Burmah about the same period. In Bombay the work began a little earlier, but in the north it was not until 1861, and in 1862 the first Forest Act was drafted. Since then the organisation had extended over the whole Empire. He rejoiced very much to hear that the results had been such as they had heard. There could be no doubt that the evils of denudation at the head waters of the large rivers were very great. He had travelled up the Indus, the Irrawaddy, and the Godavery, and of the evils brought out in the concluding chapter of the Famine Commission Report no one who had witnessed them could have the smallest doubt whatever. He had also visited the head waters of the Cauvery and other large rivers which rose in the Western Ghauts, and there could be no doubt of the terrible evils which arose from denudation. He had visited forests in 1855 and 1856, where there were wild deer in considerable abundance, but where there was now not sufficient vegetation to afford them shelter, and they had all disappeared. One of the many causes which led to denudation was the ramification of railways, for in the course of two or three years the demand for fuel alone generally led to an almost total denudation for ten or twelve miles on each side of the railway.

Sir Joseph Fayrer, M.D., K.C.S.I., F.R.S., being called upon, said he had not come at all prepared to take any part in the discussion, but he had been much instructed and interested in what he had heard, and congratulated the Society very much on the communication which had been made by one so well qualified to make it. No governing authority in India had ever done more to foster and encourage the development of science than the gentleman they had had the pleasure of listening to, and he was glad to have this opportunity of paying his tribute of admiration and gratitude for the encouragement which Sir Richard Temple had always given to science in India; he was perfectly certain that sooner or later, all scientific men would endorse that opinion. The subject of the address was not one upon which he was qualified to speak, as he had never been a forest officer, but he had always taken much interest in the question. He had seen a great deal of the forests in India, and had travelled amongst them. If there were one point which he should emphasise more than another, it was one which had scarcely been touched upon, namely, the great importance of these forests upon the health of the enormous population of that great country. That population consisted of 250,000,000, and the country was as large as the whole of Europe, excluding Russia. Although the amount of the rainfall itself might not be much interfered with by the denudation of forests, it was much interfered with as to its distribution. There were large tracts of country in India, especially in the north-west, which were almost destitute of vegetation, and it was of the greatest importance that vegetation should be encouraged in those districts if possible. That was one of the directions in which forest conservancy might be most beneficial. With reference to the question of the denudation of the hill sides, there could be no doubt of its evil results, of which

here were abundant examples in Europe; as, for instance, in Greece, and, perhaps, in Cyprus. You had only to study the sides of that great range of mountains, the Himalayas, which extend for about 1,600 miles from east to west, with an average breadth of perhaps 150, and rising to a height of nearly 30,000 feet, and pouring down from the great water-shed the enormous rivers which run east and south-west, and which would, but for the forests which clothed those hill sides, inevitably carry every year desolation and ruin by the floods they brought down. It had been said that endeavours ought to be made to cultivate the Terai, and take away the vegetation which retained the water, but nothing would be more destructive. It might be, and no doubt was, for a certain part of the year, pestilential from malaria, but if the vegetation were taken away, there would be that disproportion in the distribution of water which would be destructive. That was another direction in which forest conservancy might be well developed. Those who know the north-west provinces of India, who had been at Delhi and Agra at the commencement of the hot season, and who had travelled from there towards the east, knew that when they got within the shadow of the great range of hills, that an extraordinary change of climate was experienced; it was not a question of altitude, but of the moisture which was present in the atmosphere due to vegetation. Sir Richard Temple had referred to one very important point, the destruction of the grass; and he had seen a good deal of that. He had seen large tracks of jungle in flames, and the fire extending into the forests. He had seen large trunks destroyed and, what was far worse, thousands of young trees blighted for ever. The object of these fires was to manure the ground, but it was a most wasteful process; and it was a very wise restriction which the Forest Department had put on their officers, that they should not allow those fires to take place where they could be prevented.

Sir William Robinson, K.C.S.I., desired also to express his thanks to Sir Richard Temple. He thought there was a good deal of imagination in the idea of the arid plains of the tropical India ever having been covered with forest verdure. It had no existence in fact within the memory of man, and could not be re-created. He himself was not so complete a believer in the climatic influences of these forests. He believed that great moisture-laden trade winds of the tropics were arrested by mountain ranges rather than by trees, and Sir Richard Temple had shown that that was pretty much the case. There was, no doubt, a moisture and dewyness about forest land in the low country, but this is all that can be affirmed. He had lived all his life on the west coast, and knew what the south-west monsoon was. It is not influenced by forests. He doubted very much whether famine droughts were created or influenced by woodland denudation. No doubt denudation had occurred, valuable timbers have been cut out and used, but cultivation had very much progressed; and within the 37 years he had been in India, it had much more than doubled. On the west coast it had very largely increased, and of course the forests had disappeared; and he did not think the substitution was a bad one. Exaggeration had characterised the whole argument. He would, however, admit that care must now be devoted to the preservation of forests where they existed; but he did not think the denudation had been anything like so large or wasteful as it was alleged to have been; for there was not a forest district round the circle of mountain ranges in South India, down to the Neilgherries and up to the Bombay frontier that he had not been in. There was a question which had been very little touched upon by the lecturer, and that was the proprietary right over the forest ranges of India. Forests were valuable, they had been valuable for thousands of years, and had been appropriated. Of course no one in that room supposed that the forest ranges of the west coast of India, which had enjoyed a timber traffic of an enormous character with Arabia, Egypt, and the Gulf, time out of mind, was a "No man's land," which could be appropriated by the Government when it pleased. That was not so much the case in other parts, but still most of the valuable forests had been appropriated, and for hundreds of years had belonged to private individuals or communities: and when this forest conservancy began, it was a very difficult question how you could drive alien forest laws (alien to Englishmen as well as to Indians) in amongst the ancients people of India. There were no public forest laws in England. You had to go to Germany, Austria, and the Tyrol to see what forest laws were. They were necessarily meddlesome, and we ought to be very careful how we dealt with our native subjects in this matter. He, himself, had been deeply apprehensive and anxious on the subject, for he knew it was a difficult question, even on the continent of Europe. Usurpations began almost as soon as British administrations came into the country on the west coast; and when what was called the East India Company's monopoly of timber and wood trade was introduced into Malabar and Canara, it was sternly opposed by Sir Thomas Monroe. It was proposed by the Bombay Government to have a conservator of forests there; the experiment was persisted in for 20 years, and the history of that period was very suggestive, and one which made men accustomed to these things very thoughtful and anxious. Happily, after the monopoly had wrought a great deal of harm, Sir Thomas Monroe happened to become governor; he took the question up, and the whole of this evil was swept away in 1822. There was a great temptation to usurp and carry forestry into places where the prescriptive titles were not very clear, and likely to be menaced. He had doubt himself about the wisdom of large State monopolies of forest and timber trade. In the meantime, with the exception of some such things which would require very careful watching, the Forest Department was doing fairly well. He thought, too, that the recent law on the subject was aggressive; it provided a separate establishment for the management of these questions of property and rights; there was a Forest Settlement officer, who had to go about challenging titles, and in Madras he might be as young in the service as four years. Then the appeal was to the Forest Court, created *ad hoc*, not to the ordinary tribunals of the country, which he did not think was wise or necessary, because, from the native point of view, the executive would be less independent; he accepted this view. Again the law was excessively drastic with regard to penalties, and as far as he understood, would enable transit duties to be levied on the timber trade of the country. One thing he was very anxious about was as to the assumption by Government of proprietary right in the village forests. A large portion of India, practically, belonged to the villages, but the new law, as it seemed to him, simply did away with all village property in forests and local woodlands, and was eminently resumptive.

The Chairman remarked that the question which Sir William Robinson was opening was so large that it would require a whole evening to discuss it.

Sir W. Robinson said the Forest Law laid down that there were only State forests and private forests, and practically denied to village and communal forests any existence. The State forests might be put under strict rules, but the old village communal areas ought not to be touched by the State under any circumstances whatever. The rights of the people should be strengthened, not challenged and interfered with by the law or State executive. Forest rules are plaguing the people.

Mr. Wm. Botly said his experience of agriculture in England, and also on the Continent, showed the necessity of maintaining and extending forests. They were not only picturesque but profitable, and would

well pay for planting in belts, even in this country. On the sides of mountains and hills they afforded shelter, both to cattle and also to growing crops; and, if this were true in England, by analogy it must be so in India. Forests also fertilised the land; he knew of land which 200 years ago would produce nothing but heather, but after having been planted with trees, was so much fertilised by the falling leaves, that it now grew excellent corn. He considered that any one who planted trees was a benefactor to posterity. With regard to agriculture in India, he wished the Government model farms were more generally extended, and that agriculture was more generally taught scientifically.

The Chairman said he would not himself trespass upon the meeting more than to say that, while Sir Joseph Fayrer was speaking of the pestilential character of the Terai, it brought to his mind that, when he first went to Italy, forty years ago, the Maremma of Tuscany was quite as pestilential as the Terai of India ever was, but now, thanks to cutting avenues through the woods, and drainage, that pestilential character had almost entirely disappeared. He believed the time would come when even the Terai would no longer be looked upon with terror. He concluded by proposing a vote of thanks to Sir Richard Temple, which was carried unanimously.

Sir R. Temple, in acknowledging the vote of thanks, said he had only one word to add in conclusion. The area which he had presented, of 70,000 square miles of forest, more or less preserved, was held to be the property of the Government, the domain of the State. There might be within the domain certain subordinate rights, which he alluded to in the close of his address as the rights of the people. But outside this area, there would be the vast area of forest, of which he could not give the statistics (which must greatly exceed the 70,000 square miles), which had been allotted to the people, and in which their full right was entirely acknowledged, he hoped even to the satisfaction of Sir William Robinson himself. So that it was not to be supposed that, in preserving the forests, the Government was in any way invading the rights of the people. On the contrary, those rights would be most carefully acknowledged in the vast area of forests left in their hands, an area considered quite sufficient for their ordinary requirements. It was only regarding what might be called the first-rate forests, which had great economic and climatic value, that these important conservancy measures had been undertaken. 70,000 square miles was but a very small proportion of the total area of British India, which amounted to no less than one and a-half millions square miles, so that they had not got much more than 1-25th—hardly more than 1-30th—of the area under forest conservancy; and it would be admitted that, considering the circumstances of the Empire and its reasonable requirements, both economic and climatic, the area under forest conservancy, instead of being too much, was really too little. He hoped that one result of this subject being taken up by the Society Arts, would be the further development of forest conservancy in India, and the consequence of that policy would be certainly to benefit the natives, for, after all, it was for their welfare that the British Government in India existed.

ADJOURNED ORDINARY MEETING.

Monday, January 24, 1881; HYDE CLARKE, Esq., in the chair.

The discussion on Mr. Alfred G. Lock's paper on "Causes of Success and Failure in Modern Gold Mining," adjourned from 19th inst., was resumed.

The Chairman, in opening the discussion, said that he regretted having been unable to attend the last meeting, but he had read Mr. Lock's paper, which was a valuable contribution to one branch of metallurgy. He welcomed Mr. Lock as a fellow-labourer, having himself read a paper before the Society of Arts, on "Copper Smelting," in 1858. The paper which they had met to discuss was one of a thoroughly practical character, and fittingly brought before the Society an account of what has become a recognised department of English metallurgy, of particular importance at the present time. Although the English school had long since applied itself successfully to the working of copper, tin, iron, coal, and other minerals, gold working was a foreign pursuit, carried on by the Spaniards, Portuguese, and Germans. On the establishment of independence in South America, the English began to take a share in the gold and silver mines. In 1824 and 1825, numerous companies were formed with extravagant expectations, and many of which, although working old and rich mines, ended in disaster. A national advantage, nevertheless, accrued from these undertakings. The most intelligent captains and miners were taken from Cornwall and Wales, and they came back prepared to introduce at home still greater efficiency in their business. Abroad they made themselves masters of the native modes of working, and introduced many improvements and far better machinery. The companies, of necessity, were driven to try all kinds of new inventions and processes, and although some of them were of foreign origin, they all contributed to the formation of a satisfactory system. Some of the English companies, as the St. John del Rey in the Brazils, have continued to yield large dividends to this day, while in other cases, though the companies failed, Englishmen remained in Mexico, Chili, and Brazil, working on their own account, or in association with natives, and bringing back large fortunes. Thus originated an English school of gold metallurgy, the work of which was chiefly carried on abroad, and therefore less known. The participation of the English in foreign silver industries was no less successful, and a large business at Swansea has been established as a market for various silver ores, while at Newcastle the process of Pattinsonising, invented by Mr. Pattinson, has enabled workers to treat not only British silver lead ores, but many Spanish ores. The Americans engaged about the same time as the English in gold enterprise, and the discovery of gold in Virginia and the eastern and northern States stimulated them. When the discovery of gold in California, and of silver in that State and Nevada took place, Englishmen were quite able to deal with the business, independent of any foreign help. The discovery of gold in Australia made gold mining an industry and profession within the empire, and the works in the several colonies of that region, and of New Zealand, do honour to the knowledge and intelligence of the population. It is these processes which Mr. Lock chiefly describes with the necessary detail. Few are aware what returns mining in the colonies and foreign countries bring to those at home, apart from any investment of capital. There are the remittances for the sustenance of families, there are the remittances of earnings and savings, and great quantities of machinery and supplies are obtained from our establishments. Mr. Lock's paper comes, too, at a convenient juncture, when the gold mining of India is justly attracting attention, and when the spirit of speculation is promoting operations in Venezuela and Guyana. In reference to engineering and chemistry, gold reduction has the greatest interest, because large masses of mineral have to be pulverised by natural or other mechanical means at the smallest cost to get at a most delicate proportion of the precious metal.

Mr. Smedley repeated the observations he had made on the former occasion with regard to the importance of

-oved system in the management of mines. At -ent moment he was engaged in encouraging a which he hoped to put into practice in a short r the purpose of endeavouring to introduce, on scale, what was known as the tribute system, -eant that every one who worked on the mines -e paid by results.

-al Selwyn said, that although an admiral in the -e had been connected with practical mining -ral years, both in Western America and this He had remarked that one of the great causes -mplaints made, that there was so large a pro- of non-dividend paying mines, was the fact that -ays looked for rich ore, and took no care of the was only by impressing on them the necessity -g the last cent out of every ton of ore that that -ould be got rid of. The processes pursued in America were amongst the most perfect known. -a had given something to California, but -ia, in its clever machinery, which had been in Australia, had been the main-spring work. There were particular processes there which were, as yet, unknown in -ia. These were largely chemical processes, and -rica, when chemical processes were discovered, who discovered them was anxious to keep them as long as possible. He was tempted, by the facility by which he could take out a valid patent, it known in that way, but he did not propagate -nan did who is interested in the results of the If he were only a patentee, and not -r, he might look at the royalty rather than -d results in the mine he conducted. Some had invented tobacco juice to be put in the pans, sugar, salt, clay, and every kind of material which could possibly be useless. These things -d not kept to themselves, but where they had -ut means of really deriving a larger proportion or gold from the ore than their neighbours, -y kept to themselves as long as they could. He -a both milling and smelting in America, and they -y thought they did very well if they got be- -0 and 80 per cent. of the metal in the ore; in -ey rarely rose to that. He did not say according -rdinary assays, because they were very unsatis- He had practiced assaying to some extent, -ery little mistake in the man who urged the while the cupelling was going on would give false results. It was quite possible for a -ortion of the silver and gold present, as -s, to go up the chimney. In 1873 and 1874, Utah, he took out ore which showed 60 dollars by the dry assay, whilst, by the humid process, 69 dollars per ton out of it, showing that a large -on was escaping by the other method. -other, who was the head of the Geo- Survey in Canada, told him again and again Canada there were thousands of tons of crushed -aining sulphurets of gold containing 3 to 5 ozs. -m, and yet no one knew how to get it out. In -sent state of chemical knowledge, that was -idiculous; but the instant you went there and -d to do it, you were met by exorbitant demands part of so-called owners of these refuse heaps, a practical metallurgist had very little chance. only by the general spread of knowledge, by -ans as Mr. Lock's paper, and the discussion on any great progress could be made. The process, of which he had just spoken, was effective in getting gold and silver, since no -rs came from the Western States which did -ain gold. He had evidence of that in work- the New Consols Mine, near Callington, -shire, where the ore was very poor, and if it treated by a simple process, there would be even the poorest gold mines. This ore con- -ms 3 to 5 tons of silver, 1½ per cent. of copper, and a trace of gold, as the result of a fire assay. The results of 30 tons worked was 196 ozs. of silver, 1½ oz. of gold, 1 ton of copper, precipitate, 70 per cent., worth about £65, so that the total results were about £118 on the 30 tons of very poor stuff indeed. That process was one of roasting in furnaces with salt and, afterwards, of boiling in tanks with salt and muriatic acid. When he was in Utah in 1871, he had never seen or heard of either Anderson's, Longmead's, Augustin's, or Rhodin's processes, but it occurred to him that Nature must have had some solvent to put the metal into its present position, and he found that salt water, with a very small quantity of hydrochloric acid, used to boil the ore, would produce the whole of the contents in metal; further, that where gold, silver, lead, copper, or anything but platinum and tin, were present, it produced it in perfectly clear solution; where arsenic and sulphur were present, a chlorodising roasting must precede the operation. But at this mine in Devonshire, their great error was that they had antiquated roasting furnaces, and that the quantity treated per day could not possibly pay with such a grade of ore. If you had a very low grade ore, it was necessary to treat a large quantity per day, and if any one part of the process failed to give the necessary quantity, the whole broke down. This was one of the first requirements, but it was utterly unknown in this country. Very little known also was the furnace on the plan of Stettefelt, or O'Hara, which Stettefelt would probably say was an imitation of his. That was a process in which chlorodising roasting took place, by dropping powdered ore from the top of a chimney shaft into the flame of a furnace, occasionally fed with salt, or the salt was mixed with the ore. O'Hara did very much the same thing, but with a little less labour. This mine in Devonshire was furnished with self-acting tables, the inside worked by water-power; the rabble being fixed, it turned the ore over on the bed-plate. Stamping was not done at all, but the ore was crushed by a set of rollers, crushing it as fine as they could. In America, they wanted very much machinery which would do something more than the present stamp; and Blake's crusher served the stamps capitally, and always kept ahead, although the stamps crushed two and a-half tons per day per stamp head. In some instances, some improvement had been made by attaching rollers to the Blake's crusher; and he had heard that Mr. Marsden had a new crusher, which would fulfil these conditions. If that could be done, it was the most admirable machine which could be proposed for the mine, because stamps were very expensive, and did not do sufficient for the purpose. If you had a furnace which could roast 100 tons a day, and corresponding tanks into which to work it, either lixiviating or boiling, you ought to have a number of stamp heads sufficient to do that duty, and these stamp heads would cost more than all the rest of the plant put together. Besides that, they were extremely objectionable up at the mines, as they involved steam machinery to drive them, and you had to take enormous boilers for the purpose. He had seen teams of mules, 100 yards long, dragging a boiler up a hill; and the boilers rapidly wore out. He wanted to see a process initiated on a proper basis, with an understanding first of the chemical laws concerned, that the whole thing, no matter whether it was called the Washoe process or any other, consisted in the chlorodising of the mills; that nature, when she put the metals into the rocks, had them first boiling in a hot, salt ocean, with an excess of chlorine. If you reversed that process, you had got the same thing to the last dwt. That could not be done but by examining first the question of the furnace. Stettefelt's was a good furnace, but not the best that could be devised, because you had still to use some fuel and attention, both of which cost money; and as there was sulphur in most of the ores, which required the process

of roasting. Hollway's process ought to have shown that, if oxygen enough were used, the only fuel required was the sulphur of the ore; the arsenic might be recovered again in the flues. Having got a good furnace, the next thing was what to do with the ore. He had always advocated simple wooden tanks. In the mill he was running at Utah, they tried for some time to put in hydrochloric acid besides the salt; they usually put in sulphate of copper, salt, and some other extraordinary chemicals like those he had mentioned. Then they heated it with wrought-iron pipes; the pans themselves were generally made of wrought iron, with a flat basis of cast iron set with dies, and the muller was worked round on their lid shoes, all these being of cast iron. The most extraordinary fact came out. They got an enormous per-centage of the contents of the ore up to 93 per cent. in actual practice, and they got the silver extraordinarily pure; but, unfortunately, every bit of the wrought iron about the place began to yield to the chemical action. The silver was deposited, but it was at the expense of the pans and the pipes; they had to give up the process, unless they could constantly replace them, which was not easy in the mountains. However, an intelligent examination showed that you did not want an iron pan; you did want an iron muller, shoes, and dies, which you expect to wear out; but cast iron was worn much more slowly than wrought iron, and the pan itself could be made of wood and hooped round. In that case you would get all the chemical conditions fulfilled; what wear took place of the mullers and dies, would contribute a fine powdered iron to cause the chemical combination sought. This question of the humid process had been known to everybody connected with mining for many years, but up to 1871 or 1872, they did not give such satisfactory results as were sought, of about 46 to 60 per cent. of the metal in the ore. And he believed he was the first who ever put out anything like 26 per cent. of the metal contained. He took out a patent at the time, but it was hard for one man to fight these things. Unfortunately, everybody tried to make use of it without the knowledge which alone could make it useful. They did it inefficiently, each man taking what he had heard of, and thinking he was very wise, and that he had saved the royalty, the effect being that he made a mess of it to the extent of pounds, where he would only have had to pay shillings. This was a great misfortune, largely due to the state of our Patent-law. With regard to the management of mines, he should have been very glad if he could have run a tunnel in, when he had no hope of getting anything, on tribute; but you could not do it. The men must be sure of their pay, or they would drop their tools directly. You could not sink a shaft, you could not run a level, unless in tolerably rich ore, on tribute. It was usual to let the work on tribute when you had ore, and he always did it; in fact, it had never been the practice amongst miners in Cornwall to do anything else, and all managers of mines were too glad to adopt it when they could. They generally took a stop of which they had not a very good opinion, and said to a man, "We cannot tell what this will give; will you go into a little speculation?" A poor man could not speculate much, but sometimes he said, "I will risk it if you will set it to me at a decent rate; I don't mind taking it with a partner or two." In that way you got tribute work done, to the great advantage of the men sometimes, but at others to the great advantage of the miner; but it was a speculation, and miners could not always afford to go in for that sort of thing. As regards the interest every man took in the mine, he thought a manager's interest was very strongly secured by his pay, because if the mine did not go on and prosper he knew very well it would come to an end, and there would be no more pay for him; it was true some managers did not get paid at all whether the mine prospered or not. He had an assayer retained to assay constantly, or to look at his tools, to study new processes when there was no assaying to do. How could he ask him to work on tribute; you must have *employées*, if only the blacksmith to sharpen the tools, and there would be some day when there would be no tools to sharpen, and you could not send him away. It had been said that the dividend of steamship companies lay in their coal bunkers, and so the question of whether a mine paid a dividend or not lay in making every ton of rock pay as it came out, if possible. That was what he would really impress on everybody connected with gold mining in India, to see that there was no excuse made for anything thrown away. The assayer ought to be a thoroughly trustworthy man, and should assay what went away as well as what came out. If he did not know everything in the rock and what ought to come out of it, he was not worthy the name. When that was done, mines would prosper. There were no doubt many obstacles. Everybody engaged in mining as they did in tallow, sugar, or anything else, but it must always remain a speculation, for he never could discover that any miner could see beyond the length of his pick. Still a great deal of capital would be usefully employed in mining, and to show how largely that was not the case at present, he would state exactly what had occurred in California. Several millions sterling had come out of those mines, but if you took from Professor Raymond, or anybody else, the quantities of shafts sunk and branches and tunnels driven, it would be found that rather more had been put into the ground in the shape of labour than came out of it altogether in the shape of gold and silver, but it had enriched the country, and gave an outlet for agricultural progress, and encouraged the people to come in and settle, and did a great deal of good in many bye-ways, irrespective of the curious balance of which he had spoken. All over the world you will find the same condition of things. If you took the quantity of paying mines, and set against them the quantity of work done which did not pay, it gave about a balance. There had been a recent discovery which promised something, which he might perhaps advert to as a specimen of an idea cropping out in a new shape. A chemist in Paris had recently patented a discovery by which he proposed to get out, without roasting, from ores containing sulphur and arsenic in large quantities, all the gold and silver—not the copper; and he claimed that he had taken out, from the refuse of the Tharsis Company, more gold than they ever knew was in it. He said he used the perchloride of mercury largely, instead of quicksilver, in the grinding process, which he conducted in iron pans, and he used it in salt water. He got iron, chlorine, mercury, and some metals in combination in salt water. He had no doubt that some such effect as he claimed would be produced, simply because that was exactly what they did, in a rough way, in the Washoe process. They put in sulphate of copper and salt; the sulphuric acid left the copper, combined with the salt, to form hydrochloric acid; they had iron pans, so that they were in fact fulfilling the conditions under which per-chloride of mercury could be made, although nobody out there had any idea that that was the manner in which it was done. They all said it was something to do with the nascent copper, or some other wonderful arrangement, and they never sought for the chlorination of this process, considered why it was important, or examined how far the chlorination was carried, because both gold and silver could be carried away in a perfectly clear fluid, and the very water thrown away might, under such conditions, contain as much silver and gold as you were crediting the takings with. When his brother was head of the Geological Survey in Australia, he told him that in mercury troughs at the bottom of blankets he had often found crystals of gold much larger than could have passed through the gratings, showing that there was a formation there, owing to some galvanic action, which deposited the gold in crystals. If that were the case,

easily see how a good deal of gold and silver lost without its being suspected. If this emist had found out the way to get at the silver without roasting first, it would save a of expenditure, and in such a way as to lead true chemical reactions which took place; he e done an immense deal more for miners than one in his recollection by anyone else.

etary said it would be interesting if Mr. Lock more information about the sodium amalgacess, which he had alluded to, and which he as discovered by Mr. Crookes. The tone of the med to be in favour of mechanical rather ical methods; but it would be interesting to had any knowledge of this process on a large what was his opinion of it.

Selwyn said the process referred to had been ied in California, and was now rather dis-

reta'y said one of the objections mentioned ock was the fact of this process taking up ls. That could be readily understood, for malgamation would coat many metals; it n give a nice clean coat to quite dirty iron. ot sure whether experiments in this direction made by Mr. Crookes, but he knew they by Mr. Bolas. It had been suggested that ss might be very useful for the amalgamathe zinc plates in ordinary electric batteries, d not know if anything had been done in that nother point to which he might refer, as likely st the members, was the reference to Plattner's tion process, which recalled to his mind a in the last volume of Dr. Percy's great work, h he referred to the very beautiful process known er's process for the purification of brittle gold her metals. This, as Dr. Percy mentioned, was t before that Society as long ago as 1840, by Mr. son, in conjunction with the then Secretary, Mr. r Aikin. He produced practically pure gold from ture of gold, silver, copper, and other metals, by passing a stream of chlorine gas over the metals in a state of fusion. This process was now used Sydney Mint for the purification of gold; and if actly within the scope of the paper, was interestin showing what had been done by the Society in er years.

Fisher, being called upon, said he was not preto speak, but he should be glad to show his new ing machine, which he hoped would be finished in or two, to any one interested in the matter.

iral Selwyn remarked that Plattner's process was e time in use at La Doura, in Mexico, but the jection to it was that it took twelve hours for a and you could not conduct mining processes in y. It was a beautiful chemical process, but did ver practically on a large scale.

oon said he had been engaged for several years mining in Australia, and whilst there paid great to perfecting the operation by means of stamps, r all he had seen, he thought there was nothing it, either for speed or the fine pulverisation of Admiral Selwyn said he thought it good work o and a-half tons per stamp-head per day; t it without a Blake or any other crusher, and ame out through a grating of between 300 and to the square inch. The stamp-heads weighed d the stone was put in as large as it would go opper - as large as one's head. At first they h troubled to keep down the splash, but at last on a plan of making the water keep its own wn, and by that means they worked the stamps dry. He did not agree with Mr. Lock that gratings should be back and front; it was ry, as the same effect could be produced by using a little more water. If the outlet in front were 12 inches by the width of the stamping-box, you would get it all out. The foundations could not be too solid; and curiously enough, he had found that where water would not go, gold would, for in taking up old stamp bottoms, he had found gold where it was perfectly dry. For amalmagation they used a cradle with a circular back, in which they put the quicksilver, with a small one in front, and the speed was regulated so as just to keep the stuff lively. The action of sand upon crushed quartz, with the quicksilver in water was to give a roughness to the gold, so that the quicksilver could lay hold of it, which it would not do under other circumstances. In practice they never, except from some careless starting of the stamps too quickly, found any quicksilver in the front part of the cradle. Some years ago he was engaged on a gold, copper, silver, and lead mine in North Wales, and put up some machinery there, of a very substantial character. He would show a sample of the lead, and he had a stone now which contained visible gold, copper, and lead, and several other metals. Of course sulphur was present, and arsenic too. The mechanical mercury process there was greatly interfered with, by the great number of metals, which made it difficult to keep the cradles sufficiently lively; lead was very heavy, and it was necessary to adopt an extra mechanical process to keep it from stagnating. For several months he was at work on this mine, and the quicksilver he lost was only a very few ounces out of the 350 lbs. in use, which was practically equivalent to no loss at all, when you remembered that you could not pour mercury from one vessel to another without losing some. The lead contained a considerable quantity of silver, but the company was anxious to make it a gold mine, and nothing else, which he thought was a mistake. The other day he had a new crusher brought to his notice, which seemed very good. The objection to Blake's crusher was that the moving part was worked by an excentric; in the new machine this was replaced by a crank and lever, the friction being reduced one-half. If such a machine were used, or stamps such as he should suggest, weighing about 700 lbs., at least four or four and a-half tons would be crushed per stamp head per twenty-four hours. You could not have the stuff put into the stamps too fine, because you got a greater effect. If you put a 4-inch stone under a stamp which lifted 11 inches, you only got a 7-inch fall, whereas if the stuff was not larger than an inch, you got a 10-inch fall, and, of course, the further the fall, the greater the effect. It was very important that the best machinery should always be put up. He quite sympathised with Mr. Smedley's idea about working on tribute, but practically in many cases it was impossible. There were shafts to be sunk, adits to be driven, and so on, which men would not work at on tribute. If you got a payable ore, very likely men would take it on tribute, but not otherwise. He had known many men who would work for a time on a mine, then go to work for themselves, and when they had emptied their pockets, they would go back and work at the mine. If you could get first-rate machinery, and pay men to work it, they would be quite sufficient inducement without any tribute.

Mr. Sholl said that Mr. Lock had so thoroughly exhausted the subject of modern gold mining in his able paper, that there was little left to be said, but he should like to make a few remarks on the important question of stamping the minerals. He was of opinion that the correct principle of disintegrating any minerals containing particles of varying densities, was by imparting rapid and elastic blows, and by using a sufficient amount of water to get rid of the stamped stuff, the instant it was ready to pass the screens. The diagram of his stamping-machine on the wall showed it to be a modified steam-hammer. If, however, it were a steam-

hammer, it would be the very worst possible machine for stamping ores that could be used, inasmuch as a dead blow would smash the mineral (pyrites) and gold in a manner that would be quite fatal to the latter. The modification consists in the reaction of compressed air in chambers above and below the piston taken in, and expelled through the holes, which cushions the blow at every stroke, and renders it thoroughly elastic in its character, and especially adapted for dealing with materials of varying densities, as at speed any known mineral (including emery stone), must succumb, although still retaining the elastic blow in its perfection, as the harder the blow, the more perfect the cushion. The volume of water required per head for ordinary American quartz is about 400 gallons per hour for each pneumatic head. The guaranteed capacity of these stamps is about 10 tons of hard gold quartz per 24 hours through screens 400 holes to the inch, and with two heads in one coffer about 16 tons. Objections have been raised to the supposed heating of the air by compression and consequent loss, but the fact is, that the air is not heated at all, because the outside of the pneumatic tupp is constantly under the influence of cold running water, which ultimately runs into the coffer.

Mr. Henty said Mr. Lock, the other evening, explained the chemical combination of gold in iron pyrites, but it was always considered to be a mechanical mixture, not a chemical combination. It was also thought that there were no ores of gold. He had just come from America, and had a specimen of telluride of gold from Boulder County. He did not wish to say anything in favour of American mining, except that it was a large field, and that there were a great number of Cornish miners in America. He was glad to hear of the Indian gold fields, and hoped they would turn out successful. They would probably be worked under very different circumstances from those which formerly existed, when the mines were originally discovered. There was now a great deal of scientific knowledge brought to bear on the matter, which would facilitate the proper working of the ores and the extraction of the metal when found in connection with iron and arsenical pyrites. Allusion had been made to low grade minerals, and he quite agreed that many mines had become very profitable, when they were not successful at first, simply by putting up machinery, which enabled them to concentrate and extract the gold from ore which otherwise was not fit for the market. A mine was generally in an out-of-the-way place, far from the facilities one could desire. The first requisite to success was to have a manager really competent in every respect; and a man educated to his profession, who could combine theory and practice, was the best man. One of the first considerations in machinery was portability. Just now it was a question between stamps of various kinds; but it must be admitted that, wherever stamps were employed, they were more efficient if a crusher were used in connection with them. Most mines under companies were worked under contract work, but those owned by private individuals were generally worked under a lease, which was similar to the tribute system. He had known miners start when they first came out, and work for a company, and when they had made a little money their great desire was to find a place where the rock showed traces of mineral, and try to make money on a lease. But, where a company owned a mine, until they had proved the value of it, it was not practicable in the first place, and in the second place it would not be justified in putting men to work on lease in a mine, near to other mines worked under contract. They might be honest men, but it was not right to put temptation in the way even of honest men. There were large quantities of rich ore lying about, as a big blast would bring down two or three tons at a time. Pieces of ore might easily fall out of the bucket or skip, and there was a temptation to the me them in their pockets. The mineral was so throughout the district, that it would be impo say what mine the stolen piece came from. T men he produced was very rich, containing fr 100 ounces of gold to the ton, and a cons quantity of silver. A piece broken off the en stone he had put into a muffle, heated it to the telluride, and it left the gold thickly cove stone.

Dr. Carter Blake said he was at the gold r Central America for some time, 13 or 14 ye The Chairman must remember the fact that th in Central America a set of savages who empl the extraction of gold a much more simple meth these which had been described; who emplo *arastra* method, which was simply the rotation large stones of coarse sandstone, a system most barbarous, imperfect, and irregular ch But what did that system do? It produced per-centage of gold than some of the most i and exact processes which had been since These mines had been worked by the Spania by these wretched Indians, to a productive r an extremely small expense for labour. Som say that the saving produced was simply a qu labour; others might say that the expense of and of European mills and machinery was e heavy, and that was why they had not pa some experience in Central America led him of the story in Walton's "Angler," where t ragged boy, with a crooked pin at the end of landed a bigger fish than the elaborate angler the most expensive fishing-rod and apparatus. was one question he should like to ask practic being entirely ignorant on the subject himse where the miners in Central America got the for amalgamation before the Spanish colon There was evidence that these gold mines were but there was no evidence whatever that the kn of mercury existed amongst these Indians.

Mr. Smedley asked leave to explain, with re his suggestion for introducing the tribute syst he did not mean it to apply to dead work, sinking shafts, running tunnels, or driving a to the delicate manipulation of the quartz af mined, that is, to the crushing, amalgamati reduction of the ore into bar gold, and to the sub classifying and concentration of the tailings.

The Chairman thought there had been a litt culty in the description arising from the titl paper, which was in reality a paper of a practical character, dealing mainly with me processes. He had not, at the present mom advantage possessed by Admiral Selwyn and other gentlemen, of being practically connect these matters, but he might nevertheless be use, as he had had that intervention in forme and it was sometimes useful to bring to bear questions the evidence of one who might, call himself an interested bystander. The all apt, in looking at new inventions, t they were absolutely new, whereas further showed, as Mr. Trueman Wood had point that it was but the development of an idea w been worked at years before. Beyond his own experience, which was not very small, he h acquaintance with the history of the subject, knew that, whether with regard to the mech the chemical part, it had in all times occupied t tion of men of very great knowledge and abilit evidence they had had that evening from man men as to the way in which they had applied th to the subject, was only a repetition of what h place in times long past. There were, howev

ren apart from those to which Mr. Henty had It was easy in the laboratory to deal with tion of reduction; but the real fact was, that is hardly a district or place in which there was ie special characteristic in the mineral, and still greater difficulties in reduction works, received the ores of various districts. Mining as were begun, and the reduction was carried e best possible way, and it was, perhaps, only the end of the time that the little chemical ity was discovered which enabled that descrip- ore to be successfully dealt with. With regard ing, for instance, in some cases, the very roast- he ore had the effect of impeding the abstraction metal. In some cases you exhausted the whole mine before you found out what ought to be th it. This was a difficulty for which managers were by no means to be blamed. The truth Admiral Selwyn had said, that mining must be y a speculation. They must not, however, sup- while mining was a speculation, and while they nted to them such figures as those mentioned ck—which he knew to be accurate—that that representation of the condition of mining. ost impossible to get at the true facts, con- their economic conditions. They saw, for 50,000 put down for the capital of a mine; me to an end, and it was assumed that, as was paid, there was a dead loss of £50,000; omical fact, there was, perhaps, no £50,000 ome cases half of that had been put down sideration for the purchase of the mine, e in other ways of the same kind, and no efficient disposal of capital. Another h happened in mining, over and over his: three sets of companies, or individuals, ne, each sustained a loss, each turned over ry to its successor, and the last one made it e case of the Devon Consuls, which, with a 1,000, paid a £500 dividend on each £1 must get at the real effectual economical ascertain the real facts. Still, mining was a; and if it did not answer the purposes of it would not be carried on. When it mines were suspended for a time, and the figures became fallacious. It was true inducement to gambling, and the miner mbler in mining, and sometimes, as in South gambler outside the mine, instead of follow- cess which had been described of going and wages, and then having a turn at tribute, ng back to wages again, it too often happened ntries that, when he had made money in too often lost it in cock-fighting, monte, or form of gambling. It was a spirit of enter- induced men to follow up mining, but, could maintain themselves by it, they inly not pursue it. It was needless to say ore on the question of tribute; Mr. Smedley ed what he meant by it, and it was a system in Cornwall, and all over the world. In was no part of mining which was not a t of centuries of experience; in some cases, from the times of the Romans, or their pre- There were so many points which affected ion, and which it would be desirable, if they follow out; but, unfortunately, they had not. rd to per-centage of gold, that was no criterion. It might give a greater net et out 75 per cent. than 80, for instance. owever, one point to be borne in mind in dis- subject, and that was the great distinction operations of an individual and a company, had told them how an individual did in and in the same circumstances the same was wall, and other countries. When you came y it was a totally different affair. A company could never look after its affairs like an individual. It must have checks of various kinds. As Admiral Selwyn had pointed out, you must have an assayer—you must go on feeling your way by his help; but an individual who had a small working did not burden himself with an assayer; he had a good piece of ground, and worked it out in the best way he could. The position of a company was totally different. It must have, apart from the dead work of the mine, a great deal of dead work in the shape of administration. The same forms must be carried out in the beginning before it was ascertained whether the company would pay or no. It mattered not what it was, in any mercantile operation, wherever there was a number of partners, a totally different system of checks was required to those which would do in individual undertakings. Those things were open to abuse, and the only remedy could be what was pointed out by Mr. Lock, Admiral Selwyn, and others, the application of intelligence, and looking to the character and integrity of those employed. He thought he could answer the question put by Dr. Carter Blake, as to where the mercury came from before the Spaniards went to South America; the only answer being that no mercury was employed at all, and that constituted the difference between the old system of gold working and that inaugurated by the Spaniards. Under the old workings, men could only work for gold where it was visible, and where it could be got at mechanically; they began by working up ingots, and then worked up any rich ores of which there was an outcrop. The lesson to be learnt from these things was, that under the proper application of refined processes they were liable to get a much larger amount of gold in the gross than could be obtained by the old and ruder methods. It was almost inconceivable the small amount of gold per ton with which a mine could be made to pay. It was not necessary to make any defence of Mr. Lock in treating with the mechanical conditions, because they must necessarily precede the chemical or metallurgical treatment. You must first get out your ore, and put it in the state for chemical treatment. In conclusion, he proposed a cordial vote of thanks to Mr. Lock for the very valuable paper he had brought forward.

The vote of thanks having been carried unanimously,

Mr. Lock replied on the whole discussion. He said that at the last meeting a gentleman asked him a question about gold mining in Transylvania, and if he could explain why it was not profitable to the Government. He could not answer that very fully, because the Government only worked one mine there. Of Hungarian gold mines generally, and Transylvanian in particular, he had a very high opinion. There was no fault with the mines, the faults lay in the deficiency of capital to work them, and in the treatment of the mineral for the extraction of the gold. But many of the private mines did pay, and the Government mine also paid a considerable amount. There was no doubt they could all be made to pay much more if properly worked with sufficient capital. He agreed with Mr. Smedley, that they wanted a better system of managing most of the gold mines in which English capital is invested. He was disappointed that Mr. Fisher had not said more about his stamping mill, because it was a new idea, only brought under his notice within the last few days, and there were certain parts of it he liked very much, though there were others he did not like at all. It seemed to him that the speed being 500 or 600 blows a minute was a step in the right direction, but its having no cushion, and having a dead blow, seemed to him at present a fatal objection. Again there seemed no means provided in it of letting the free gold, after it was once crushed out of the ore, get into some place where it would not be smashed. He was in hopes they would have had many persons there who would have gone into the question of fine stamping versus roast-

ing, because there was a great deal to be learnt on the subject, and the sooner they knocked their heads together and got some information out of them, the better. He thought that Mr. Fisher's machine was more fit for dry crushing, which was another point not touched upon, how far dry crushing was superior to wet crushing. He exhibited a tracing of Walworth's aspirator, which was being adapted to extract the material out of the coffer as fast as it was stamped, separating it by gravitation in air instead of in water. All these points had to be considered and discussed. He had with him three samples of crushed ore, one of which had passed through a grating of 900 holes to the inch, another through a grating of 2,916 holes to the inch, and the third through a grating of 4,624 holes to the inch. He should like some of the gentlemen present to take some of the latter powders and rub them in the palms of their hands, when it would feel just like fine flour. He must thank Admiral Selwyn for the admirable manner in which he had treated the subject, and was sure he would not object to his differing from him in several important points. The Admiral told them a great deal about America and American systems. He (Mr. Lock) cared only about the process of treating ores, whether it came from America, Australia, or anywhere else; he simply looked at the system with practical common sense, to see whether there was anything in it or not. Of course, he was liable to error, but he endeavoured to exercise his common sense, and he must say it did not seem to him common sense to crush gold and all the material as fine as flour, and then be at all surprised that the gold went away in the water. With regard to the different processes which Admiral Selwyn had touched upon, they were used for the treatment of ores containing copper, silver, lead, and a variety of other things, whilst his paper dealt only with gold. He did not touch on the Washoe process, because it was essentially a silver process.

Admiral Selwyn said it was available for gold.

Mr. Lock said it was available only for a silver ore containing gold, in his opinion. Admiral Selwyn had said that the Plattner process had been abandoned in America. The same thing had occurred also in Australia, because it did not answer. It answered admirably in Germany, but there was a peculiar combination of circumstances which made it answer there. That was a difficulty with which one had to deal—the varying conditions in different countries. What he had striven to do was to point out a simple method, which was being proved by practice to be successful. This was shown by assaying the tailings every hour or two hours to see how much was going away. That was the only test, but the extraordinary thing was he could not get anybody in America to give him an assay of the tailings. It did not seem to him there were any assays made.

Admiral Selwyn said he had been superintendent of mines out there, where it was done constantly every two hours; and he did not know a single decent mill in Western America where it was not done.

Mr. Lock said he could never get them. Many gentlemen gave him their processes; but when he asked where they had been tried, and the result, and what where the assays of the tailings, he never could get such assays. It was not much advantage assaying the ore before treatment, because the amount consisted of that which you got out, and that which went away; all you wanted to know was what went away; and if over five or six per cent. went away, there was something radically wrong. Admiral Selwyn told him that there they only got out 70 or 80 per cent., and that exactly bore out what Skidmore, Hague, Raymond, and everybody else in America had said, they did not get the gold out within about 25 to 30 per cent. Now, in Australia, by *the method* which he had attempted to describe, only five to seven per cent. was left in the tailings. regard to this chloridising process, it could not in every country, because the materials m exist; there might be a want of fuel and of Australia it was found that using salt was for auriferous copper ores. Admiral Selwyn t about a wonderful process for getting gold material which did not show gold by assay he happened to be talking the other day to o most eminent practical metallurgists who ha thousands of tons of similar ore, and in speaki different patents and new ideas, allusion was one of a similar character, of which his friend " Ah, yes, that is a wonderful process, they get a-half ounces of gold out of a ton of stuff, by assaying, no gold could be found." "How in the world did they do that; surely be a swindle." "No," said his friend, not; it was done honestly enough. They it over amalgamated copper plates, and the had been used not long before for some ve material; some of the gold from the rich mater stuck on the plates, and then, when they came t the plates off, they found the gold; and, of co very small quantity in an experiment, makes large quantity per ton, and thus they mana get one and a-half ounces of gold out of ore contained not one grain." He merely mentioned show that you must not always believe a thing wonderful success because an experiment or tw made with it, and the assay turned out well. only by treating many hundreds or thousands of to any process could be thoroughly tested. The pro had attempted to explain had been used for milli tons, and had proved successful. That was the q with any process, would it stand the test—wa simplest and the best? With regard to Mr. suggestion, that only one screen was necess thought that point had been already met, and require further notice. Sodium amalgam had tried in Australia, and had not been found succ There was a great deal in it no doubt, but it was a ticklish thing to play with, and unless you had educated men than at present, it would not much into use, though in course of time more mi done with it. The result which he drew from the discussion was that the subject was not half exha What they wanted in this country was a Gold Ins similar to the Iron and Steel Institute; a place at papers could be read and discussions take place, which every man who had an idea on the subje get it discussed, and thus very soon find out w he was correct or not. He believed that such a tute would have that effect, and gold mining wou an absolutely fresh start, and you would get capital invested, because it would be better stood. As far as he was concerned, he was ready to hand over to such a society all his and papers, and he thought he could say many books which were not obtainable in En if others would come forward and do the same might get up something really practically With regard to the improved stamps, Mr. Mo not seem to approve much of them, but th differed from him. He did not say they were gold mining at the present moment, but wit alterations, they certainly were a step in th direction. He happened to have some go coming over from Asia Minor, and if Mr. Fish Sholl, or any other gentleman liked to have it t in their machines, and let people come to see work so as to test their capabilities, he sho very happy to let them have it. In conclus thanked the meeting for the attention they had the subject.

The Chairman said in the usual course of th duty would have been finished, but Mr. Lo

out a proposition which he was sure his former ... on the Council would be willing to . He had often urged on his old friends in the ... trade to found a Copper Institute, and with regard ... ld and Silver Institute there could be no question would be very valuable. They could not expect members at first, and there would be difficulties , but if Mr. Lock would address a letter to the , he was sure they would lend him assistance, in the early stages would be of service. They ... give him the use of rooms, and save preliminary ... in various directions. In that way, as Mr. ... Wood had jogged his memory, many valu... institutions during the last 100 years had been under the fostering care of the Society of Arts, which were still at work, doing a great deal of

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...EEDINGS OF THE SOCIETY.

...IGHTH ORDINARY MEETING.

...ay, January 26th, 1881; ROBERT ..., C.B., Vice-President of the Society, ...

...wing candidates were proposed for ...nembers of the Society:—

Clayton, 64, Portland-place, W.
..., Barrow-in-Furness.
...e L. M., 46, Grosvenor-street, W.
...ert, Tovil-house, Maidstone.
...n Evelyn, 4, Breakspears-road, Brockley.
... M., Q.C., 1, Plowden-buildings, Temple,
...rge, jun., Beaconsfield-house, Godolphin-
...ames, 18, Urswick-road, Lower Clapton, ...hall, Hackney.
...axwell, F.C.S., Cotford, Oakhill-road,
...imus, Castle-house, 44, Mildmay-grove, ...ark, N.
..., Joseph, Hartsholme-hall, Lincoln, and ... Works, Lincoln.
...e S. V., The Westminster College of
...ce McMurdo, F.R.G.S., Hesket-house, 54, ...street, Russell square, W.C.

...wing candidates were balloted for, and ... members of the Society:—

...ntonius, 87, Seymour-street, Hyde-pk., W.
... Ball, F.R.G.S., Carisbrooke-lodge, St. ...d East, Putney.
...lward, Streatham-hill.
..., 88, Richmond-road, Bayswater, W.
...ichard William, 18, Cockspur-street, S.W.
... Peter, M.D., Ellora-villa, Silverhill, St. ...n-Sea.
...rraclough, The Warren, Torrington, Devon.
...ry Tennyson, Wigan.
...illiam Kennedy, 8, Gloucester-square, ..., W.
...n Barnwell, The Grove, Esher, Surrey.
... Martin, 117, Leadenhall-street, E.C.
...he Louis, Burton-in-Lonsdale, Yorkshire.
...obert Alleyne, South-lodge, Cockermouth, ...d.
...iam Phillips, Drapers'-hall, Throgmorton-...
Smee, Arthur R., Penrhyn-lodge, Woodberry-down, N.
Standfield, John, 6, Westminster-chambers, S.W., and 44, Lillieshall-road, Clapham, S.W.
Surtees, Colonel Charles F., Chalcott-house, Long Ditton, Surrey.
Tapson, John, M.D., 12, St. German's-place, Blackheath.
Theobald, John Peter, The Chestnut-grove, Kingston-on-Thames.
Thompson, John, Mayor of Peterborough.
Timmis, Illius Augustus, 17, Parliament-street, S.W.
Waterlow, Herbert Jameson, 1, The Avenue, Brondesbury, N.W.
Wiggins, Rev. William, Spring-vale, Tonge, Middleton, Lancashire.
Wilson, Rev. Charles Thomas, Chapmore-end, Ware.
Wood, James, 26, Cross-street, Ryde, Isle of Wight.
Wright, E. G., 330, Commercial-road, Landport.

The paper read was on—

SUGGESTIONS FOR PREVENTING LONDON SMOKE, AND MAKING IT COMMERCIALLY AVAILABLE.

By W. D. Scott-Moncrieff, C.E., F.R.S.S.A.

It is sometimes difficult to account for sudden movements of popular opinion. When once they begin, an element of momentum seems to take the place of the previous inertia, and the new form of social force appears frequently to be directly proportionate to the one which preceded it. We are now in the midst of one of these movements of opinion that is not difficult to account for. The interest which at present attaches to the question of how best to obtain the blessings of an uncontaminated atmosphere, has arisen out of a state of things with regard to smoke and fog, that is recognised as dangerous to the whole community. The work of relating the means to the end has commenced in earnest, and there is every likelihood that, before long, the public will be put in possession of information as to how the problem is most likely to be solved.

Some apology is, perhaps, necessary on my part to those who are at present exerting themselves as specialists in this field of inquiry, for not having laid my proposals before them to the exclusion of other channels. I am sure, however, that if any of these gentlemen were in my place, they would have thought twice before rejecting so favourable an opportunity as the one which has been presented to me. The Society of Arts has already identified itself with this important subject. I trust that further facts and information may be brought to light by this additional discussion, and that they may prove useful to the committees whose praiseworthy efforts are, at present, being exerted for the public good.

The present position of the question renders it far from easy to know how best to deal with it before a scientific audience, who are well informed. Materials which were important contributions a few months ago, have already been assimilated, and no longer lend themselves to the further elucidation of the subject, I trust, therefore, I may be permitted to confine myself to the special scheme which I propose, and I need not say with what pleasure it is that I do so, when I tell you that, although it has occupied my thoughts for years, this is the first occasion upon which I have addressed an audience on the subject.

I wish, first of all, to attempt to make clear to you in a few words what is the present aspect of the question as regards the methods and apparatus employed.

The classification of the methods may be arranged as follows:—

1. Burning bituminous coal at a single operation, by exposing it to the heat of the fuel previously ignited. It is unnecessary to say that this method embraces nearly the whole of the domestic consumption of Great Britain, and a great part of the commercial consumption as well.

2. Separating the gas from a cheap quality of coal, heating it in an apparatus known as a regenerator, and using it without the solid residue.

3. Separating the gas from the coal at a comparatively low temperature, adding the partly coked residue of a previous charge to the fuel in the furnace, and passing the gas through the burning mass.

4. Using coke as a basis, and passing gas through the fuel as a means of supporting its combustion, both coke and gas having been obtained from a gas company.

5. Using fuel from which a certain proportion of gas has been extracted, which is the special subject of the present paper.

As regards the apparatus, it naturally follows the classification of methods or systems, and would far exceed the compass of this paper to describe in any detail. It will be well, however, for me to say something of the more familiar appliances which are in every-day use, and to remind you of certain fundamental principles that are common to the whole of them. As you are all well aware, the combustion of bituminous coal depends upon the combination of certain gases, and of carbon and oxygen at a high temperature. It is also familiar to you all, that the oxygen necessary for this combustion is obtained from the atmosphere we live in. One necessary feature of the process is the creation of a draught, which is obtained, as you all are aware, by the action of a heated column of air in a shaft or chimney. But this invariable accompaniment of combustion is, in the nature of things, associated with a movement, not only of the air, but of the gaseous elements of the fuel, and it is almost inconceivable that the necessary quantities of oxygen can be obtained without this element of rapid movement. The question comes to be then, whether or not the mean velocity of the air and gases necessary to supply the oxygen, is compatible with the time that must elapse in order to obtain the necessary chemical combinations at the point of sufficient temperatures, which is in the body of the fire itself.

Now in the case of freshly added bituminous fuel placed on the top of a burning mass, it is quite certain that the conditions of a draught are inconsistent with complete combustion; and this brings us to a consideration whether or not it is possible to consume bituminous coal perfectly at a single operation, and leads to doubt as to the possibility of using the first method successfully in any apparatus, however ingeniously it may be devised for the purpose. Certain proposed processes are sometimes so inconsistent with the operation of invariable natural laws, that a conclusion on the subject of their failure has the certainty of a complete induction. If depended upon its success on the water to run up hill, as in the case of London house drains, we should be s its failure. The matter, as regards combustion of fuel at one operation, in this elementary category, but, tc is very near to being so.

I am sure many present will sympa in the great difficulty of making cl matters that do not contain within the elements of a complete inducti duction may be so far complete, as re that the mind is forced to a defini but the discrepancies may, neverth very elements which go to form a po another direction. I do not know way of illustrating my meaning than to several well-known fields of inv at one time, seemed to be altogetl which have become gradually clo advance of scientific knowledge. F the early days of steam locomotion, tl been many persons who thought it on the part of certain engineers to selves to the principle of the atmosp It must have appeared to them that to predict the failure of science in whilst anticipating its triumphs in a yet, I have no doubt, that men did that time what was practically a comp in their own minds, however difficult it to convey their arguments conclusiv Now, I do not know of any problem which gives a greater promise of a s than the burning of an ordinary piec coal. The elements of combustion available, but, up to a certain poin selves readily to a partial solution of Nothing is more easy than to get a an ordinary grate, and nothing is than to get it to burn in such a way shall escape up the chimney. T failure of all appliances for all ti attain this object is, therefore, on th apparently rash anticipation, and nothing in the scientific aspect of th suggests any other conclusion to m not so much inclined to this opini arguments that present themselves result of experiments on a small s from those which may be gathe experience of persons engaged in th of fuel on a large scale, where the for carrying out complete combust tionably favourable.

Taking the iron trade as a typic may say that all experience in th cleanliness and economy is tending r a total abandonment of the att bituminous coal at one operation. which perhaps presents the greates this rule is the blast furnace. The which the consumption of fuel is ca apparatus, would of itself place it in position as affording peculiar facilit ing an intense and constant tempe here, however, the operation is b great extent, divided, and the uti waste gases for heating the air stov

iat, even with all its peculiar advantages, blast is unable to carry out complete com- at one operation.

is an illustration of a blast furnace of a not mproved or modern type, but which is nt to show the immense advantage the tus has over anything that one can conceive ur present state of knowledge in respect of estic appliance. The temperature is not only enough to melt iron, but it is maintained one month's end to another with the skill siduity of trained workmen. The air is not introduced in immense volumes by means of ul blowing-engines, but is heated to a high perature before it reaches the fuel. The artist I think, somewhat exaggerated the volumes oke escaping from the mouth of the furnace, its presence at least shows he was conscious of stance. Now, as a matter of economy, these gases are utilised in the modern practice of melting, but if they exist at all under con- so favourable to complete combustion, what say of appliances that burn a few pounds at a time under the charge of an over- housemaid? I am not speaking now of ombustion, but only of that fair amount consistent with a smokeless chimney.

irds other departments of the iron in- ie attempt to consume bituminous coal at peration is being altogether abandoned. irs of Dr. Siemens, as embodied in his ive furnace, have gone far to bring about in the direction of scientific principles, 'rice's furnaces, as now used at Woolwich are also an illustration of improvement aken place in the same direction. I shall ion to speak of these appliances presently. iout saying that arguments drawn from nels are altogether conclusive, I must say g with other considerations, they go far he formation of an opinion that in cases scale of the consumption is smaller, ill be still more impossible of attain- s regards the scale of appliances that ler the head of domestic apparatus, hat the problem of consuming ordinary s coal at one operation will ultimately oned altogether, but it is beyond all that it will ever be satisfactorily solved. irs ago, this opinion would have been on as unreasonable. I have long been that it is a sound one, and this upported, not only by several eminent s, among whom I may number Dr. ut also by the whole tendency of the mprovements which have been carried great national industries. I believe it of a theoretical proof; but even if this ing, I think I am justified in pointing sent condition of our large towns as a tion of the failure of existing appliances. vast amount of invention which has ided upon the problem of the complete n of bituminous coal at one operation nto account, and when it is considered ne appliance has ever been altogether I think there is a strong *prima facie* out against the practicability of the If I may be allowed to put the argument possible in the form of a syllogism, with regard to domestic hearths, I might say all bituminous coal requires a high temperature steadily maintained for its complete combustion. Domestic fires are incapable of producing a high temperature steadily maintained, therefore domestic fires are unfit for the complete combustion of bituminous coal. To hold an opposite opinion with regard to the element of temperature is inconsistent with the facts, and to insist on the high temperature being continually maintained is to deprive every citizen of his right to allow his fire to go down when the heat he obtains from it has become excessive. I might quote many authorities in support of these opinions. Even in the case of steam-boilers, where skilled labour is available, and where a high temperature, evenly maintained, is an important point, Dr. Angus Smith shows clearly that it is heat that is required for the complete combustion of the fuel, and that the supply of air in sufficient quantities is comparatively easy. I will suppose the case of an absolutely perfect domestic appliance for the combustion of bituminous coal, and I will ask the inventor of it where the heat has to come from that is essential to the process, when the fire has been allowed to go almost out, and the housemaid adds fresh fuel.

So far, I have tried to put the matter before you as regards temperature, but a moment's consideration of the actual process of combustion will, I think, make it equally impossible to escape from the conclusion to which I have come, even as regards the supply of air itself. Burning coals depend for their incandescence upon the passage of air among their exposed surfaces. In an open brazier, it may pass in from all sides, and underneath as well. So far this is a most favourable condition, but as it passes through the burning mass the oxygen is consumed, and it is impossible to insure that the air does not reach some parts of the fuel in an exhausted state. I have here a simple illustration of my meaning. This common paraffin lamp is so arranged that a current of air passes in close contact with the flame from the wick, and the oxygen is consumed in its passage. I will now suppose that this piece of bituminous coal, which I place over the top of the funnel, holds an analogous place to that which it might assume in the most ingeniously constructed stove imaginable, that is to say, some point at which the air, which has already passed through the fire, reaches it exhausted of its oxygen. The temperature of the lamp flame is sufficient to produce an escape of gas, and upon passing my hand over the funnel this is proved by the pungent smell of the gaseous products. Now you will find, that although the gas is escaping, the conditions are altogether inconsistent with combustion of any kind whatever. Upon striking a match, and bringing it near the top of the funnel, you will see that it is instantly extinguished. I now take a piece of smokeless fuel, and place it over the funnel, instead of the piece of coal. It goes without saying that although there is no more chance of combustion in the one case than there is in the other, still no smoke escapes, and, as far as the atmosphere is concerned, no harm is done.

I might multiply arguments indefinitely; but as time is of importance, I must ask even the un-

believing to accept my conclusions in the meantime, and simply point out that if they are right, the idea of adapting domestic hearths to the complete combustion of ordinary bituminous coal may be abandoned at once and for ever. If smoke were like certain gases that burst into flame at a low temperature when they escape into the air, there might be some chance of obtaining a satisfactory result. But the fact that it does not ignite, even in contact with a red-hot piece of iron, shows how temperature, beyond the capacities of an ordinary hearth, is essential to its perfect consumption. I have here a list of the gases contained in ordinary coal:—

	Manchester gas.		Gas as supplied to Houses of Parliament.
Hydrogen	52·71	....	41·71
Marsh gas	31·03	....	41·88
Carbon monoxide	4·47	....	4·98
Olefines	11·19	....	8·72
Nitrogen	—	....	2·71
Carbon dioxide	0·58	....	—
	100·		100·

Now, some of these gases combine with oxygen much more slowly than others, so that some of them, in the case of an apparatus depending upon a draught (and I know of none in the nature of a domestic appliance that does not depend upon a draught), would be half way up the chimney before the combination was complete.

If these conclusions are right, an immense amount of ground is cleared as regards the solution of the problem, because the knowledge of what will be successful is, in nine cases out of ten, arrived at by discovering what cannot be successful in the nature of things. The conclusion means, in other words, either that the use of ordinary bituminous coal must be abandoned altogether, or that some apparatus must be devised for domestic purposes, similar, on a small scale, to those which have been introduced in our great industries, more especially those in the iron trade, to which I have already referred. This brings us to speak of the second and third methods, and I shall do so in as few words as possible. I do not see how these can possibly be carried out, for the simple reason that on the large scale skilled labour and the means of maintaining a constant high temperature are essential features of complete combustion, and neither can possibly be present with any certainty in the case of domestic fires. Dr. Siemens has hit upon an ingenious plan, by which he makes use of the operations of gas companies to separate the operation of combustion, it may be, miles away from the point of domestic use. This is the fourth method I referred to. By burning coke with gas flames burning through it, he avoids the difficulties of separation as regards the consumer, and carries out a scientific system of combustion at the same time. I propose, however, instead of this, to use a modified condition of bituminous coal, and I will try to show the advantages of doing so. It might be presumption on my part to say that I am the discoverer of this sort of fuel, but I may say that, so far as I know, I am the first to bring it into public notice.

First, I may say that, with regard to anthracite coal, if the principle of smokeless fuel is once recognised and enforced, the stone coal will fight its way, and be of great service, not heating agent, but as a wholesome sou petition as well. It is as a means of smoke and improving our light that I fifth method, and I shall go on to desc

About ten years ago I made a series ments upon the separation of the proce bustion which led me to think very hi class of fuel to which I refer. I pla D retort in a common Cornish steam bo lowering the position of the fire bars, a apparatus for the distillation of gas fr in ordinary use, and after some time h I discharged the gaseous contents of the the furnace. In this way I secured complete combustion by a separation into its constituent parts of solid c hydro-carbon products. The semi-co sulted from this short distillation was smokeless, and I have since disco by treating it with water when hot, as of coke, renders it still more smokeless. I am aware, it is the most perfect fuel i as it has all the cheerfulness of ordinar none of the disadvantages arising fro tion of smoke.

I must now ask you to turn your the present condition of London as fuel, and to make an effort to realise h actually stand. Leaving out of questi which is consumed by the public, I w realise the fact that there are about four of coal consumed in London every year. conceive of this more readily, as a with a base of about 200 yards, bu upon all sides, to the height of the St. Paul's Cathedral. This is what for the purpose of obtaining heat, i to the surplus coke sold by the gas Bearing this in mind, I must now ask to realise another quantity—viz., abou tons—used for the purpose of obtai This would be represented by a cube yards at the base, built up to a height All this vast quantity is passed throu and, after a large amount of bad gas h tracted from it, it is converted into cin coke. Now, it has entirely escaped that the gigantic appliances necessary f the one heap of coals on a long extra bad results, is capable of extractin quantity from both heaps of coals extraction, with good results both as and fuel. The fuel would be similar to resulted from the experiments I have the illuminating power of London ga approximately doubled, and the aniline ammonia, and other products of the distillation, must be doubled as well.

To those who may be ready to excla the vast capital which will be require out this operation, I will now show is that no additional plant is necessary obtain this result. We will begin by illustration. Supposing one of the companies were to begin to-morrow t and sell coal from which only 3,000 cu gas had been extracted per ton. The f cheap to the consumer at 23s. per ton to start with, the company would recou

for coal, which we will suppose cost them on an average about 16s. per ton. But, in order to keep up its normal production of gas, so soon as a retort was discharged, it would simply need to be charged again. In this manner gas would be coming away from the retort all day long, just as formerly, with slight loss of time to be allowed for the additional frequency of the charging. As, however, the gas under the proposed arrangement comes off much more rapidly than under the existing system. The supply at the end of the 24 hours would be in excess of that which is obtained from the long extraction, and in this way less and not more plant would be necessary to give the same quantity in a given time. But instead of bad 12-candle gas, they would have 20 or 24-candle gas to dispose of, with double the quantity of bye-products to the good in addition. What applies to the case of one small company would of course apply equally to the whole combined.

I have already trespassed on your time at considerable length, but as there are no doubt many present who prefer an ounce of practice to a hundredweight of theory, I think it well to tell you that my scheme has already been tried out at Woolwich Arsenal when all other methods had failed to supply the establishment with sufficient light. When I say my scheme, I say so with important limitation in this particular case, because when I went to explain the proposal to Mr. Wallace, who is one of the most scientific gas managers in the kingdom, I found he had already been in the habit of adopting it. Curiously enough, however, he had never generalised from the facts, and until I pointed out the wide application of which it was capable, had not thought of it as a means of utilising the smoke of our great cities. During the long winter evenings, the available plant at the Arsenal frequently falls short of the demands that are made upon it. Under ordinary conditions, the supply of 16-candle gas is insufficient for the purpose of supplying light, and if we take quantity of this to be, say, 100 cubic feet per unit of time, then if 20-candle gas were substituted, the quantity of light would be increased proportionately, that is to say from 100 to 125, in terms of a photometric measurement. Now, not only is this result obtained, as regards the quality of the gas, by simply removing one charge of coals at the end of four hours and substituting a fresh one, but larger quantities of the better gas are obtained, and that for two reasons. First of all, the gas comes off in greater quantities per unit of time on an average short extraction than on an average long one; and the fuel used for heating the retorts being greatly superior to ordinary coke, assists the operation still further. In this way, then, the superiority of the short extraction is proved in all directions. I have here a few specimens of the fuel. No. 1 represents an extraction of 3,000 cubic feet per ton; and if it were used in London, this city would be rendered practically smokeless. I must explain, however, that the experimental retort does not give a fair specimen of the fuel. Measurement by the meter is the only method of guessing at the amount of extraction; but this is by no means a satisfactory test of the equable character of the distillation. That is to say, that the 1¼ cubic feet of gas which come away from 1 lb. of coal in an experimental retort, although a satisfactory test of the extraction being at the rate of about 3,000 cubic per ton, may, nevertheless, have come to a great extent from the outer surface of the sample, leaving the interior both bituminous and smoky. In an ordinary extraction on the large scale, the fuel may be taken as smokeless, and in every way suitable for domestic consumption.

Perhaps, the most pleasant way to conclude this paper would be to draw a picture of the present state of London overcast, filthy, given to fogs, grievous to breathe in, with the London of the future, clear as the tops of the Surrey hills, if the fuel I have been describing were in universal use. I must ask you instead, however, to follow me through a few figures which explain the financial bearing of my scheme upon the community generally.

First, then, as regards capital expenditure, I propose to take advantage of the existing plant of the gas companies. I find they are amply sufficient for the purpose.

Instead of taking 10,000 cubic feet of gas per ton from the coal, I propose to take 3,333 cubic feet, and to pass three times the quantity through the retorts, or any other proportion that may be found most convenient. The result of doing so is startling.

The companies will have double the quantity of by-products they have at present in the shape of tar and ammoniacal liquids; the community will have 24-candle gas instead of 16-candle gas; the fuel resulting from the process will light readily, and it will make a cheerful fire that gives out 20 per cent. more heat than common coal; London would become a smokeless city.

In dealing with the figures, I shall take them roughly, but in such a way that by including a few outlying corporations they could be made absolutely correct.

I take the total annual consumption of coal in London to be 6,000,000 tons. Of this I take 2,000,000 tons to be the annual consumption of the gas companies. The total quantity of fuel used for general purposes I take to be 4,000,000 tons of coal and 1,000,000 of coke sold by the gas companies.

We shall now see what would be the result if we treat the whole of the 6,000,000 tons in the retorts on an extraction of less than three hours, instead of the six hours at present prevailing.

The total quantity of 16-candle gas consumed in London may be taken at 2,000,000,000 cubic feet. This would be at the rate of 3,333 cubic feet per ton upon 6,000,000 tons, the total quantity of coal consumed in London. The residual smokeless fuel would amount to 5,100,000 tons. Of this 1,000,000 tons would be required for the extraction of the gas, leaving 4,100,000 available for the general uses of the community. This has to be compared with the 4,000,000 tons of coal and the 1,000,000 tons of coke already referred to as consumed at present. Now, the smokeless fuel which results from an extraction of 3,333 cubic feet of gas per ton has a heating capacity fully 20 per cent. greater than common coal, and 10 per cent. greater than coke. This gives us the exact equivalents of the 5,000,000 tons of fuel at present in use.

So far the account, as regards the fuel available

for the community balances. We may now deal with the difference in value between 16 and 24-candle gas. As the value of the gas varies directly as its illuminating power, the calculation is very simple. If we take the average price of 16-candle gas to be 3s. 6d. per thousand cubic feet, we shall find the total value of the 20,000,000,000 consumed in London to be £3,500,000, but as we have by my scheme the same quantity of 24-candle gas, the value will be increased to £5,250,000; here then we have an annual sum of £1,750,000 to place to the credit of the system.

Turning now to the by-products: seeing the gas companies, by the new arrangements, would subject three times the quantity of coal to the heat of their retorts during the period when the tar and ammoniacal liquors pass off most rapidly, I do not think I am wrong in estimating the yield at double its present amount. Taking this upon the tar and ammonia to yield 3s. 9d. per ton of coal, we find the total value of these by-products to be, at present, on the supposed consumption by the gas companies of 2,000,000 tons of coal per annum, £375,000. This being doubled under my scheme, an additional sum of £375,000 must be placed to its credit.

But the basis upon which we have hitherto been arguing is that the gas companies under the proposed scheme are getting their coal for nothing. We have been supposing that the community become the purchasers of 6,000,000 tons of coal and hand it to the gas companies. At present London only pays for its general consumption on 4,000,000 tons of coal and 1,000,000 of coke. Let us now suppose that the companies pay the same sum annually that they do at present for their coals; if so, they would pay upon 2,000,000 tons, or an annual amount of £1,600,000, if their coals cost 16s. per ton. From this falls to be deducted the money they at present draw from their sales of coke, which, when taken at 6s. per ton of coal carbonised under the existing system, still leaves a sum of £1,000,000, which they could afford to pay per annum for the use of the 6,000,000 tons of fuel as proposed in my scheme. We will now take the total payments of the community for their coal to be upon 6,000,000 tons, for which we will further suppose they pay at the rate of 16s. per ton first cost. This would amount to £4,800,000 per annum. From this has to be deducted the £1,000,000 contributed by the gas companies for the use of the fuel, also the £1,750,000 charged on the difference between the 16 and 24-candle gas already referred to, also the sum of £375,000 of additional income from the by-products. This would leave a net sum paid by the community for its fuel under my scheme of £1,675,000. Under the present system they have to pay, say 16s. per ton on 4,000,000 tons of coal, and say 12s. per ton on 1,000,000 tons of coke. This makes in all the sum of £3,800,000 per annum. Here then we have a balance in favour of my scheme of £2,125,000 annually. This may be taken as the yearly value of London smoke, which I propose to convert into useful products by the plant at present in use.

. I have only, in conclusion, to say one or two words about the efficiency of the scheme as regards the fuel. It lights easily, it gives off no smoke, it makes a cheerful fire, it gives out more heat than either coal or coke, it will be cheaper per heat-unit than the coal at present in use, London wou come a smokeless city, and all that would be deducted from the sum of £2,125,000 per would be confined to a few items, such as t of additional workmen employed in chargi retorts, interest upon additional capital requi transit appliances, and the terms to be mad the gas companies for carrying out the sche

I have much pleasure in acknowledging tl I have received from Mr. Wallace, the gas m at Woolwich Arsenal, and the valuable in tion obtained from Mr. Field's tabulated ac of the London gas companies. So far as aware, my contributions to the *Builder* an where are the only writing on the subject proposal that has ever been made public. I say, in conclusion, that I have no pecuniary i whatever in the scheme I propose.

DISCUSSION.

The Chairman said the lecturer had explain to consume smoke was a very difficult process, fact, as far as he understood the problem, th real remedy was to prevent it from coming into ex Smoke consisted principally of carbon, and requ large proportion of oxygen to be combine it, and time could not be obtained in a f or in the flue. They knew that the most perfec powder manufactured and exploded in the most way possible, was never wholly consumed, bu portions of the grains—sometimes very large por were driven out unconsumed. That showed th culty of getting carbon into combination with a su quantity of oxygen to produce full combustion. reader of the paper spoke of Dr. Siemens having pr a mode of extracting a species of crude gas fr poorer classes of coal, but that it was not intende applicable for general purposes. That, howeve a mistake, as Dr. Siemens did intend to supp gas for all heating purposes to town commu and a Bill was prepared and taken into Parliam Birmingham for that purpose. It was to be and distributed as ordinary gas was, for purposes for which heat was required. He ha spoken of 16-candle gas being 3s. 6d. per 1,000 London, but the companies in London were gu charge 3s.: one on the Southern side charged 2s. the large Becton Company was charging 3s. 3d would, no doubt, shortly reduce it to 3s. Ther been many complaints during the present frost, affected the gas in many ways. It reduced its v by condensation to the extent of 5 per cent. froze the taps and pipes serving it; the result bein at the London Company Board meeting that day had about 2,000 complaints of want of proper during last week. The amount of coal said annually required for London was four millio which would impoverish more than 1,000 acres of three feet in depth. If, therefore, they could i way diminish the enormous and disgraceful wa fuel going on in this country, they would be d great national good. They were now using abo million tons of coal per annum, about 100 m being used in this country, and 10 millions bei ported; and it was of the highest importance go on exhausting our coal-fields at the presen rate. Last evening he spent in company with eminent chemist who had studied this questic Robert Angus-Smith, being chief inspector un Alkali Act, and he had kindly written him a which he would ask the Secretary to read. He then call on the meeting to discuss the paper; asked them to keep as nearly as possible to the s

following letters were read by the Secretary :—

Local Government Board, Whitehall,
26th January, 1881.

DEAR MR. RAWLINSON,—I feel sure that you ve an interesting paper from Mr. Scott-Moncrieff ening, but it will do no harm to send you some by no means in opposition, but with the belief he subject must be viewed in many ways. In my of proceedings, under the Alkali Act for 1878. tion a plan, actually in use in Bességes, in the of France, of making coke by distilling the coal, ving all the products of distillation. I got the count, and have had it translated and published. said that the coke is better than by air treatment, gh some people deny this. Now, I show that if ated the 15 million tons of coal now used for in this way, we should have a saving of 3½ pounds direct, but the sulphate of ammonia, d as manure, would add eight million pounds of food to the produce of the land. If, er, we treated all the coal in the same way, we add about 50 million pounds worth of bread and might begin to export. The calculation amount of food is made from results ob- y Messrs. Gilbert and Lawes, the greatest of horities, and is confirmed by letters from The value of the tar is separate from that. Part must be done. Is any work more important? of a revenue in amount fit for all the purposes t nation. The sulphur itself would be of great tead of poisoning us in fogs, and hurting us ies, as much of it would be commercially I am trying to stir up some people interested naking. I should like to see Mr. Scott- 's plan tried where coke is not wanted, and, re ought to try every good plan.—I am, cerely, R. ANGUS SMITH.

awlinson, Esq., C.B.

cription of the Bességes plan, referred to, is e-book. Alkali Act Report, presented to it, 1879.*

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ondon Gaslight Company, Works, Nine-elms, S.W.,
25th January, 1881.

AR SIR,—We used 155,468 tons of coal last year, yields ten gallons of tar; one ton yields, say, ve gallons of ammoniacal liquor. Our tar last worth £17,814; liquor about £14,000. I drew r two some days ago, after the charge had been urs. Found it very difficult to draw, the soft king up before the rake; the smoke, in draw- a nuisance. The coke was very friable, was o quench, and would be little more than dust e or twice handling. Moreover, to carbonise hat extent only would require a much larger of fuel than is ordinarily used. I regret very t I cannot be at John-street to-night.—Yours y, ROBERT MORTON.

awlinson, Esq.

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ughton wished to put two questions which to him of some importance, and which he had ent scientific knowledge to answer for himself. followed Mr. Moncrieff aright, the fuel which ed was practically identical with that which rs ago was universally used in locomotive en- fore railway companies felt themselves at pollute the atmosphere. He remembered, y, asking what they did with the gas, when d it would not pay to collect it. Whether that was correct or not of course he could not say, but he did know that almost every railway company in England and France had abandoned the use of coke, and he always understood that they did so because it did not pay to use it; and many of the coke ovens by the sides of railways had been pulled down. He should like to know the precise cause of this abolition, because this was an experiment on a very large scale, carried on for a long time. The other question was with regard to the quality of the gas made. It appeared to him that, not perhaps immediately, but in the not distant future, the greater part of the gas consumed in this country would be of a lower illuminating power, but giving more heat, than that now in use; and they must look to the electric light in some form or other replacing, to a great extent, the present mode of lighting. He did not believe this would affect the gas companies prejudicially, but he thought they would have to manufacture a different quality of gas, which would be used for cooking, heating, and as a motive power.

Mr. W. R. E. Coles (of the National Health Society) said there was about to be an exhibition of the various means by which the smoke of London might be prevented; and amongst those means gas would be particulary considered. He might say that the committee had had various recommendations from several gas companies, and on the committee they had a member of one of the London gas companies. The committee had also before it several useful inventions for improvements in the flues of houses; there were also inventions for reducing the smoke from bituminous coal by chemical means, and in particular there were several improved forms of grate for burning anthracite coal for domestic purposes. Since this movement had become popular, anthracite coal had been considerably introduced into London, and in many cases with success. As usual, in all important social matters, the Royal voice had been expressed in favour of the movement, and on the following day, at Kensington, Prince Leopold would preside at a meeting, one branch of whose business would be to consider the atmosphere of London in relation particularly to smoke.

Mr. Wolstencroft said that in 1873, there was an exhibition at Manchester of appliances for the economy of fuel, when his father, who was a clergyman, showed a fire-grate of his own devising. There had been a letter in the *Times* recommending that air should be brought in from outside to supply the fire, so as to prevent draughts in the room, and his father accordingly made a hole through the wall and admitted air from the outside. He found that inconvenient, as it blew the ashes into the room, but that difficulty was got over by fixing a piece of slate in such a manner as to confine the air entirely to the fire. This gave a very good fire indeed, and the combustion was so active, that for six months they used no other fuel than that obtained from a large heap of cinders and ashes at a neighbour's farm. Some hundreds of these grates were fitted in Manchester, but the public did not take them up, and the patent was now run out, so that anyone was at liberty to use it. Ordinary gas coke gave a better fire than coal with this grate, and anthracite coal would burn freely. Indeed, on one occasion, when there was no other coal at the exhibition at Peel-park, his father's was the only fire which would burn.

Mr. Hugh Clements thought the waste of fuel and the smoke of London had got to such a pitch that some means should be taken to lessen it. It seemed to him that the plan now brought forward would do much to abate the present nuisance, but any other means which would attain the same result should also be tried. There was no doubt if the gas companies took up this question, and dealt with it in the manner proposed, it would be a great success, as the quantity and quality of gas would be much increased, and also the by-products. With

* cts, 1863 and 1874. Fourteenth and Fifteenth Annual the Inspection of the Proceedings during the years 78. Eyre and Spottiswoode. Price 2s. 2d. "Manu- ke at Bességes," p. 48.

regard to the consumption of coal in ordinary houses, there was no doubt it was about twice as much as it ought to be; houses were built with no regard to ventilation, which could only be obtained from badly fitting doors and windows, causing draughts. Great economy would be effected if a whole street were warmed by one large furnace, for all such operations were always better conducted on a large scale.

Mr. Engert thought too little care was generally bestowed on the way in which coals were stored; for he found, as the result of many experiments, that dry coal gave the gases out freely and caused but little smoke; when it lay for some time exposed to the air and absorbed moisture, it gave three or four times as much, and when it had been exposed to showers of rain it produced ten times as much smoke as dry coal. Unfortunately, most of the coal in London was kept in cellars exposed to damp and rain, and in one house where he lately went to see an experiment tried, it was so wet it would hardly burn. He had lately been talking a great deal to engineers and stokers on the matter, and they sometimes told him that the wind was very unfavourable to them, though they hardly seemed to understand why it was so. He thought every furnace ought to be so enclosed that the wind would not affect it. A great deal was said about the economy of the fuel for poor people, and he had no doubt that with a good cheap kitchener they might save a large quantity of the coal which now simply went up the chimney. He had an invention of his own, but he would not refer to it on the present occasion.

Mr. Webber said he would endeavour to bring the discussion back to the question at issue by asking Mr. Moncrieff one or two questions. He said that more heat was given out from this partially carbonised coal than from raw coal. If this was weight for weight, he (Mr. Webber) did not exactly see how coal from which a certain weight of combustible had been drawn could possibly give out as much heat as if all that combustible remained in it. Mr. Morton, in his letter, touched a very serious point when he said that he had tried drawing a charge of coal, 1½ or 2 hours after it was put in, and he found great difficulty. He had had some experience in the matter, and he could bear out Mr. Morton's statement in that respect. It was always possible to see in a gas works when the coal was properly carbonised, without going near the retort; for if it came out too soon it made a most tremendous smoke. Unless Mr. Morton's statement could be shown to be wrong, if only one third of the gas was produced, three times the weight of coal could not very well be burned off, and if that were not so, the existing plant could not do the work. If it was possible to partially carbonise three times the amount of coal in the same time, the case was very different, but from Mr. Morton's statement, supplemented by the experience of every gas manager, he did not think it was altogether clear. He would call attention to the report of Dr. Ballard, who carried out a long inspection of various manufacturing processes where noxious vapours and smoke were given off, and he partially drew attention to the fact that, when coal was not properly burned off in gas works, a very great nuisance was occasioned in the neighbourhood. The present system might be all wrong, but if it were, the gas companies would not be at all backward in taking advantage of any better system that would give them one or two per cent. more dividend.

Mr. Lowson desired to express the great pleasure he had felt in listening to this very able and interesting paper. To him the idea was theoretically perfect, and if it could be carried into effect, he had not the slightest hesitation in saying that London would be smokeless to-morrow. The volatile products were of course now *being wasted* and sent up the chimneys, and if they could be first utilised, as Mr. Moncrieff had shown destructive distillation in retorts, there was no d[oubt] they would all be sources of revenue to the commu[nity] and it would clear the air of large towns of smoke. [The] last speaker had referred to the statement with re[gard] to more heat being given out by this fuel than [raw coal,] but that arose from the large amount of heat now [lost] used in volatilising the products of the raw coal. That disappeared, and would reappear in the fuel which [would] be supplied. He had been much struck with the fi[gures] given, showing the great economy which had [been] effected. Assuming six million tons of coals to be [con]sumed annually in London, and taking them a[t an] average price of £1 per ton, that was £6,000,000, which it was reckoned there would be a savi[ng of] £2,000,000. But he did not think account had [been] taken of the extra labour which would be requir[ed to] work three times the present amount of coal in th[e gas] works. He had not much hope of the scheme [being] adopted in London just yet, but if Mr. Moncrieff [would] go down to Birmingham and read his paper, and [could] show that a saving of £100,000 could be effected [there,] he had little doubt it would soon be taken up.

Mr. Lawry Whittle said that, as a member [of the] committee of which Mr. Coles had spoken, he ha[d had] many discussions with various people as to the best [means] of preventing smoke. There were several methods [pro]posed, especially the introduction of new appli[ances] and of new fuel, including anthracite and coke; a[nd it] was very important that these things should be put be[fore] the public in a clear and systematic way, as had [been] done that evening. He had found anthracite useful, [but] had not yet heard anything so important as this p[aper] on the question of coke, and he looked to the pro[posal] as one of the most important means of meeting the[...] He was happy to think that the people were begin[ning] to recognise the evil as one within the scope of [their] own energies to deal with. They had to deal in Lon[don] with a public of several millions; they could not, in [his] opinion, deal with them by legislation, but must [show] them the remedies, and by degrees induce them [to] adopt them. Mechanical appliances might attract s[ome] people, different fuels would attract others, and amo[ng] these, partially coked coal had always presented i[tself] to him as one of the most promising.

The Chairman, in concluding the discussion, said [he] presumed Mr. Moncrieff would take his coal for c[oking] purposes as new as possible. This was an impor[tant] point, because gas coal was very volatile, and if i[t lay] on the surface for any length of time, it very rap[idly] depreciated, from 5 up to as much as 25 per cent. W[ith] regard to the value of the waste products, if all the [coal] now burned in open fireplaces were so treated as to s[ave] those tarry and residual products, which now went [up] the chimneys and only did injury, available as t[hey] were in gas works, the result would be astonish[ing.] Mr. Morton, in his letter read by the Secretary, [told] them that, at the London Gas Works, about 155,000 [tons] of coal were carbonised per annum, and the real profits in tar and ammoniacal liquor were £31,814. [If] they multiplied that by 13, which would bring i[t to] nearly 2,000,000 tons, that would represent a sum [of] £413,582, which was now sent into the London at[mos]phere to do nothing but mischief. It was quite [clear] Mr. Moncrieff did not propose to exhaust the coal t[o the] same extent as the gas company did now, and wh[ether] that would reduce the volume and relative value of [the] residual products he was not prepared to say. [With] respect to the remarks of Mr. Morton as to the diffi[culty] of drawing the retorts, no doubt there would be that [diffi]culty with the retorts, as they were arranged at pre[sent,] because he knew Mr. Morton intimately, and knew [him] to be an extremely careful and intelligent man, [who,] like the reader of the paper, he came north of [the] Tweed. Whether the process would be the same [in] partial distillation, whether the apparatus woul[d]

ie, whether the retorts would be the same, not prepared to say; but it was quite clear he could be made by different processes and rent manners. It was true, as had been said, ilway companies did once use coke entirely ir locomotives; but he did not know that id abandoned it so much on account of the y, though that had certainly come into the ; but the first engines were small, and the fire-were also small, so that they could not use coal to eir steam. They had now enlarged their fire-nd arranged their apparatus so perfectly that they n crude coal. But they did not formerly use the ch Mr. Moncrieff contemplated, but used a coke pecially, from which all the residual products were into the atmosphere, smoke and all, and nothing st but the bare carbon; which, according to the from the gas works, really had the least value. Moncrieff intended to preserve all the residuals e coke as well, he did what the coke makers for companies never did. Again, though the old ns were abandoned, the making of coke was went on to a large extent, because it enabled ers to turn their small coal, which had little to a product which had great value for the of smelting, puddling furnaces, and for steel whilst the heat which came from the ovens rasted, but was utilised for steam purposes.

tt-Moncrieff, in reply, said the most im-oint, perhaps, raised, was that mentioned ter from Mr. Morton, who had evidently ractical experiment. This weighed very with him; and he had no hesitation in at if his plan were adopted, great skill, competitive skill, would have to be brought the production of the best form of fuel. One ples he had with him, from which 6,000 feet ton had been taken, was, like that described rton, exceedingly friable; but another sample means so friable. In an experiment such as n spoke of, he believed an exceedingly spongy f coal ensued, which, no doubt, would have ed. The tar began to exude; and at that stage of distillation the coal would hardly age at all. It might be that special means e to be taken by the gas companies; the fuel ompressed; or it might be treated in various t if the object to be attained was such as to be the opinion of the meeting that it he had no doubt that the fuel might be ectly available for carriage and for use. had been with difficulty withdrawn from the t with the others it was not so. The atomic or condition of the material was exceedingly nd some skill would no doubt be required to to the best effect. The Chairman had plied fully to the question put by Mr. as to early locomotives. As to the electric e were various views with regard to it, and inly could not say whether it would come ext year, the year after, or in two or three his were really a reasonable scheme for dealing isance which was affecting the health of the nunity, and it could be carried out at no great d without much trouble, even looking at it as y remedy, it would be better to adopt it than definitely for a light about which, to say the was a great deal of discussion. Mr. Webber the heat in this fuel could be greater than in stimating it at 20 per cent., he had spoken ect information, but Mr. Lowson had pointed planation of the present anomaly. If you of coal and a quantity of water, to turn into steam required an enormous quantity of he condition into which the water was con-the thermal equivalent of the change. ame with the coal; it required a considerable amount of heat to convert it into gas, and there was a thermal equivalent in the one case the same as in the other. By treating it in an open fireplace, the appearance was very cheerful, but an immense deal of heat was absorbed in the process. It was for the same reason that the wick of a lamp was not consumed. It was very near the flame, which was at a very high temperature, and yet it was not consumed—except very slowly—because between the flame and the wick the process was going on of converting the oil into the gaseous constituents, which represented the thermal equivalent, and kept the wick practically cool. A difficulty had also been suggested with regard to the smoke, but that was really a matter of detail, which would be very easily dealt with. A large funnel could be easily arranged over the mouth of the retort, with an exhaust fan which would carry off the smoke, and the men would be better off than at present, the smoke, of course, being taken into the furnace. He had not, as Mr. Lowson supposed, overlooked the question of additional labour, though he had not gone into it in detail, as it was difficult to estimate exactly. He believed it would approximately amount to trebling the number of men employed, in which case perhaps £100,000 might be expended.

The Chairman then proposed a vote of thanks to Mr. Scott-Moncrieff, which was carried unanimously.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock:—

FEBRUARY 2.—"Trade Prospects." By STEPHEN BOURNE.

FEBRUARY 9.—"The Present Condition of the Art of Wood-carving in England." By J. HUNGERFORD POLLEN. Sir PHILIP CUNLIFFE-OWEN, C.B., K.C.M.G. C.I.E., will preside.

FEBRUARY 16.—"The Participation of Labour in the Profits of Enterprise." By SEDLEY TAYLOR, M.A., late Fellow of Trinity College, Cambridge.

FEBRUARY 23.—

MARCH 2.—"Flashing Signals for Lighthouses." By Sir WILLIAM THOMSON, LL.D., F.R.S.

MARCH 9.—"Improvements in the Treatment of Esparto for the Manufacture of Paper." By WILLIAM ARNOT, F.C.S.

MARCH 16.—"The Manufacture of Aërated Waters." By T. P. BRUCE WARREN.

MARCH 23.—"The Increasing Number of Deaths from Explosions, with an Examination of the Causes." By CORNELIUS WALFORD.

MARCH 30.—"Recent Advances in Electric Lighting." By W. H. PREECE, Pres. Soc. Tel. Eng.

Dates not yet fixed:—

"Buying and Selling; its Nature and its Tools." By Prof. BONAMY PRICE. On this evening Lord ALFRED S. CHURCHILL will preside.

"The Discrimination and Artistic Use of Precious Stones." By Prof. A. H. CHURCH, F.C.S.

"The Compound Air Engine." By Col. F. BEAUMONT, R.E.

FOREIGN AND COLONIAL SECTION.

Tuesday evenings, at eight o'clock:—

FEBRUARY 1.—"The Industrial Products of South Africa." By the Right Honourable Sir HENRY BARTLE FRERE, Bart., G.C.B., G.C.S.I., D.C.L., LL.D. Sir RICHARD TEMPLE, Bart., G.C.S.I., C.I.E., D.C.L., will preside.

FEBRUARY 22.—"The Languages of South Africa." By ROBERT N. CUST.

MARCH 15.—"The Loo Choo Islands." By Consul JOHN A. GUBBINS.

APRIL 5.—"Trade Relations between Great Britain and her Dependencies." By WILLIAM WESTGARTH.

APPLIED CHEMISTRY AND PHYSICS SECTION.

Thursday evenings, at eight o'clock:—

FEBRUARY 24.—"Deep Sea Investigation, and the Apparatus used in it." By J. G. BUCHANAN, F.R.S.E., F.C.S. Captain Sir GEORGE S. NARES, R.N., K.C.B., F.R.S., will preside.

MARCH 24.—"The Future Development of Electrical Appliances." By Prof. JOHN PERRY.

The meeting previously announced for April 7 will be held on May 12.

INDIAN SECTION.

Friday evenings, at eight o'clock:—

FEBRUARY 11.—"The Gold Fields of India." By HYDE CLARKE. Sir WILLIAM ROBINSON, K.C.S.I., will preside.

MARCH 4.—"The Results of British Rule in India." By J. M. MACLEAN.

MARCH 25.—"The Tenure and Cultivation of Land in India." By Sir GEORGE CAMPBELL, K.C.S.I., M.P.

MAY 13.—"Burmah." By General Sir ARTHUR PHAYRE, G.C.M.G., K.C.S.I., C.B.

CANTOR LECTURES.

Monday evenings, at eight o'clock:—

The Second Course will be on "Watchmaking," by EDWARD RIGG, M.A. Three Lectures.

Syllabus of the Course.

LECTURE I.—FEBRUARY 7.

Introduction—Units of Time—Historical Sketch—Description of usual forms of watch—Escapements—Conditions of accurate timekeeping, and arrangements necessary for their maintenance in the higher class of watch.

LECTURE II.—FEBRUARY 14.

The ordinary watch—Degree of accuracy required in it—Systems of manufacture in this country and abroad—Description of specimens illustrative of the various stages of construction—Comparison of the several systems.

LECTURE III.—FEBRUARY 21.

Necessity of efforts to promote the art in this country—Need of education, theoretical and practical, in horology—Literature—Great want of uniformity in gauges, screws, &c.—Exhibition of ordinary and complicated watches, and of watchmakers' tools—Conclusion.

The Lectures will be illustrated by Specimens, Models, and Diagrams. The different movements, &c., will be shown enlarged on the screen by means of the Aphengiscope and the Electric Light.

The Third Course will be on "The Scientific Principles involved in Electric Lighting," by Prof. W. G. ADAMS, F.R.S. Four Lectures.

March 7, 14, 21, 28.

The Fourth Course will be on "The Art of Lace-making," by ALAN S. COLE. Three Lectures.

April 25; May 2, 9.

The Fifth Course will be on "Colour Blindness and its Influence upon Various Industries," by R. BRUDENELL CARTER, F.R.C.S. Three Lectures.

May 16, 23, 30.

ADMISSION TO MEETINGS.

Members have the right of attending Society's meetings and lectures. Every can admit *two* friends to the Ordinary and Meetings, and *one* friend to the Cantor Books of tickets for the purpose have be to the Members, but admission can also be on the personal introduction of a Membe

MEETINGS FOR THE ENSUING WE

MONDAY, JAN. 31ST...Royal Geographical, University Burlington-gardens, W., 8½ p.m. Mr. E. Del "A Journey to Semiretchia and Kuldja in British Architects, 9, Conduit-street, W., C. Purdon Clarke, "Persian Architectur struction."
Institute of Actuaries, The Quadrangle, Ki W.C., 7 p.m. Mr. T. B. Sprague, "The and Use of a Series of Select Mortality used in connection with the Institute. Hm. Parts II. and III.
Medical, 11, Chandos-street, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., Mark Pattison, "The Thing that might be

TUESDAY, FEB. 1ST...SOCIETY OF ARTS, John-str W.C., 8 p.m. (Foreign and Colonial Se Right Hon. Sir Henry Bartle Frere, Bart., trial Products of South Africa."
Royal Institution, Albemarle-street, W., 3 E. A. Schäfer, "The Blood." (Lecture III
Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion upon "Deep Coal in South Wales." 2. Mr. Charles Col mouth Dockyard Extension Works."
Pathological, 53, Berners-street, Oxford-street
Biblical Archæology, 9, Conduit-street, W., 8
Zoological, 11, Hanover-square, W., 8½ p.m.

WEDNESDAY, FEB. 2ND.... SOCIETY OF ARTS, Adelphi, W.C., 8 p.m. Mr. Stephen Bou Prospects."
Geological, Burlington-house, W., 8 p.m. M. Duncan, "The Coralliferous Series of Connection with the last Upheaval of the 2. Mr. P. Herbert Carpenter, "Two New C the Upper Chalk of Southern Sweden."
Entomological, 11, Chandos-street, W., 7 p.m
Pharmaceutical, 17, Bloomsbury-square, W Prof. Redwood, "The Weights, Balances, a Employed in Pharmacy, the Errors which a Occur in Using them, and Means by which Required in the Weighing and Measuring may be Promoted."
Archæological Association, 32, Sackville-stree 1. Mr. W. H. Butcher, "Exploration of Villa, Bromham." 2. Dr. Phené, "Recent in the Mounds of the Troad, &c."
Obstetrical, 53, Berners-street, Oxford-street, Annual Meeting.

THURSDAY, FEB. 3RD...Royal, Burlington-house, W.,
Antiquaries, Burlington-house, W., 8½ p.m.
Linnean, Burlington-house, W., 8 p.m. 1. Bentham, "Notes on Cyperaceæ." 2. Day, "Observations on some British Fish Wm. Biddie, "Remarks on the Coffee-lea India." 4. Dr. M. C. Cooke, "Coffee Dise America."
Chemical, Burlington-house, W., 8 p.m. 1. and Hake, "The Estimation of Organic Ca 2. Mr. M. W. Williams, "The Action of Zinc Couple upon Nitrates."
London Institution, Finsbury-circus, E.C., R. H. Scott, "Three Years of Daily W casting."
Royal Institution, Albemarle-street, W., Francis Hueffer, "The Troubadours." (I
Civil and Mechanical Engineers, 7, Westminst S.W., 7 p.m. Mr. W. C. Street, "Draini banking with regard to River Outfalls."
Archæological Institution, 16, New Burli 4 p.m.

FRIDAY, FEB. 4TH....Royal United Service Institute yard, 3 p.m. Colonel T. Lynden Bell, "T Defensive, by Infantry in Extended Order.
Royal Institution, Albemarle-street, W., Andrew Wilson, "The Origin of Colonial C
Geologists' Association, University College,
Philological, University College, W.C., 8 p.m

SATURDAY, FEB. 5TH...Royal Institution, Albemarl 3 p.m. Prof. Sidney Colvin, "The (Lecture III.)

L OF THE SOCIETY OF ARTS.

No. 1,472. VOL. XXIX.

IDAY, FEBRUARY 4, 1881.

tions for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

EXHIBITION OF 1851.

uncil have had under consideration the of erecting a memorial on the site of the hibition of 1851, and have decided that it very desirable that such a memorial erected. The following letter was sent cretary of the Commissioners of Public ho has replied that the Chief Commissioner it Hon. G. S. Lefevre) would receive a n from the Council on the subject:—

23rd December, 1880.

The Council of the Society of Arts have me to request you to inform the Com-s of Public Works that they consider it lesirable to record, by a monolith, the he Great Exhibition of the Works of of all Nations, held in 1851 in Hyde-id they propose to raise the necessary a public subscription, a task in which ect no great difficulties. It is necessary the consent of the several official ies, and when that has been secured, to e sanction of her Majesty the Queen.

ouncil therefore apply for the permission ommissioners of Public Works, to place in irk, near the spot where the Queen opened ibition on the 1st of May, 1851, a Mono-ranite or other durable stone, with suit-criptions. The design, treatment, and n of such Monolith would, of course, be o the approval of the Commissioners.

ouncil have deputed Mr. F. J. Bramwell, V.P.Inst.C.E., Chairman of the Council; ry Cole, K.C.B., a Vice-President; and n Roberts, M.A., one of the Treasurers of ty, to confer with the Commissioners on ct, and, in view of carrying the design t, to seek permission to use the ground.

ation, in respect of Arts, Manufacturers, merce, and general civilisation, has derived est benefits from the Great Exhibition of ich has already been the progenitor of ernational Exhibitions in all parts of the world; and there seems every probability tinuance of them.

iety will appeal with confidence to the the funds necessary to make a memorial the object, and likely to last for many Everybody must feel a pride that this country was the originator of the first International Exhibitions, and especially the hundreds of thousands of individuals who have derived direct personal benefit from them.

I have, &c.,

H. T. WOOD, *Secretary.*

A. B. Mitford, Esq.

In accordance with the appointment made by Mr. Mitford, on Monday last, the 31st January, a deputation, consisting of the Chairman, Mr. F. J. Bramwell, F.R.S., Sir Henry Cole, K.C.B., Dr. B. W. Richardson, F.R.S., Mr. Owen Roberts, M.A., and the Secretary, had an interview with the Right Hon. G. J. Shaw-Lefevre, M.P., the First Commissioner of Works, and Mr. A. B. Mitford, the Secretary of the Board. The deputation discussed the question with the First Commissioner, who stated that if he could be satisfied an adequate and suitable monument could be provided, he would be prepared to recommend that permission should be granted for its erection on the spot in Hyde-park, where the Great Exhibition building stood.

The Council will endeavour to raise subscriptions for the purpose, and will submit a more detailed scheme to the First Commissioner of Works, as soon as they are able to come to a decision upon the precise character it is desirable the monument should take.

NATIONAL TRAINING SCHOOL FOR MUSIC.

The Council, at their last meeting, resolved to make a grant of £160 to the National Training School for Music, in answer to the application from the School for a renewal of the four Scholarships founded by the Society.

LABEL FOR PLANTS.

The Council are prepared to award a Society's Silver Medal, together with a prize of £5, which has been placed at their disposal for the purpose by Mr. G. F. Wilson, F.R.S., for the best label for plants.

The object of the offer is to obtain a label which may be cheap and durable, and may show legibly whatever is written or printed thereon; the label must be suitable for plants in open border. These considerations will principally govern the award.

Specimen labels, bearing a number or motto, and accompanied by a sealed envelope containing the name of the sender, must be sent in to the Secretary not later than the 1st May, 1881.

The Council reserve to themselves the right of withholding the Medal and Prize offered, if, in the opinion of the judges, none of the specimens sent in are deserving.

PROCEEDINGS OF THE SOCIETY.

APPLIED CHEMISTRY AND PHYSICS SECTION.

Friday, January 27th, 1881; J. C. Stevenson, M.P., in the chair.

The paper read was on—

A NEW MECHANICAL FURNACE, AND A CONTINUOUS SYSTEM OF MANUFACTURING SULPHATE OF SODA.

By James Mactear, F.C.S., F.I.C.

The manufacture of sulphate of soda—or "salt-cake," as it is termed in the alkali trade—is, as a branch of chemical industry, second only to that of sulphuric acid in importance. It is the first stage, so to speak, in the production of alkali, or "soda ash," and bleaching powder, articles which are essential in most of the industries of our country.

The process is a very simple one. Common salt is mixed with sulphuric acid, and the mixture is exposed to heat in a furnace, the resulting products being sulphate of soda and hydrochloric acid gas. In practice, however, the process has various drawbacks, the escapes of gas, more or less in amount, are very annoying to the workmen, and the labour is severe.

During the early days of the alkali manufacture, the operation of "decomposing" the salt was conducted in a small furnace of the reverberatory class, and all the acid vapours were allowed to escape into the air through the chimney. As the trade or manufacture grew in importance, and the quantity of salt decomposed rapidly increased, the damage to crops and vegetation generally, and the great nuisance occasioned by the evolution of the acid gases, caused such complaint, that measures of some kind or other were adopted by all manufacturers to lessen the amount of acid gas escaping. Many ingenious plans were tried with more or less success. That of Mr. Gossage, however, rapidly proved its great superiority over all the others, and it is now adopted by almost all manufacturers of alkali.

While the gaseous products were thus being dealt with, constant endeavours were also being made to improve the construction of the furnaces, but not with the same complete success as in the condensation of the acid gases. These, even so early as 1839, had become such a source of nuisance that we find a patent actually taken out by a Mr. Ford, with a view of carrying on the operations connected with the decomposition of salt "on board a flotilla at sea, at such a distance from land so that the gases may not reach shore."

It will be interesting to follow the gradual changes which have been made in the form of, and manner of working, the furnaces from time to time. Originally the furnace employed in Great Britain was a simple reverberatory furnace, and in it the salt and acid were mixed on the brick hearth, and the acid fumes allowed to escape with the products of combustion into the chimney. As a considerable draught could be used with this furnace, the workmen say that they were rarely incommoded acid gases.

After the invention of the bleaching-process, by Charles Tennant, in 17[illegible] chlorine was produced from a mixture manganese, and sulphuric acid, until ab year 1823, when a system of decomposing in furnaces, and condensing the hydrochl[illegible] in water, came into use. In the first instanc[illegible] iron cylinders were used, and the condense made of earthenware pipes, and packed i cases with flints or pebbles. About this ti furnaces with two beds or divisions were intr these having been previously used in Franc[illegible] already, in 1816, the firm of Chaptal and [illegible] were condensing their hydrochloric ac utilising it in the manufacture of gelati[illegible] bones. Amongst the old papers of my fir is an interesting series of letters from the named gentlemen, in which, under date o they say they were then working 44,000 l day of crude soda (black ash). of 20 per cer per cent. alkali, and were using salt prod[illegible] Marseilles by the evaporation of the sea-wa consumption of sulphuric acid being state[illegible] per cent. on 100 salt.

In the gradual alteration of the f from the simple reverberatory with sing the first change was a mere altera[illegible] form of the single bed, which was made in form and dished out into a basin-lik[illegible] This furnace was used for a number of ye[illegible] went under the name of the "Dandy furna[illegible]

The following extract from an old pape[illegible] manufacture of salt-cake, is interesting:—

"The muriatic acid is the alkali manufacture bear, proving an intolerable nuisance to the bourhood, if allowed to escape into the air, a[illegible] exceedingly troublesome to condense perfectly. salt-cake is made in such furnaces (the Da[illegible] evolved muriatic acid is so intermingled with smoke, that its complete separation is nearly quite, impossible. The only method is by pas mixed gases over an extensive surface of col[illegible] but this, if carried on sufficiently to condense t[illegible] of the acid, would, by cooling the air, des draught; in practice, therefore, it can only succeed. The greater part of the acid may drawn, and the nuisance thus materially lesse[illegible] some must still escape, and prove, to the neig[illegible] farmers' annoyance, that the remedy is ineffec[illegible]

The next stage in the development of t[illegible] cake furnace, was its construction with t[illegible] instead of only one, as previously used. T or decomposing bed, being at one time with a leaden pan, lined with brickwor the roaster bed was bottomed with bric In a short time the leaden pan was repl one made of cast iron, built up in pla likewise lined with bricks, and this f furnace was used somewhat extensively fo[illegible] years. On May 8th, 1837, however, Bell patented a furnace which introdu muffle principle; the furnace, or oven, as h[illegible] had only one bed, was constructed with pan, protected both outside and inside l work, and arched over with a double that the fire gases, after first passing tl series of flues underneath the bed or heart[illegible] over the top between the two arches, so t bottom and top heat were secured.

ea was apparently quite a new one, and it :dily improved upon by J. C. Gamble, in ırch 14th), who proposed the use of three , ovens, or retorts, one to be used as the sing or mixing portion, and each of the lternately were to receive, and finish the rom the first division when it had been up. Lee almost immediately afterwards xl a form of open furnace, in which a cast-or pan was employed, spoon-like in form. e again improved upon this form of pan, ong a furnace with two roasting beds, and shallow pan heated by the waste heat from ers passing over it, was in use.

this point invention seems to have been into two channels, first, towards the pro-of the largest amount of strong muriatic ding to the development of the close or ırnace, and second, towards the cheapest of producing salt-cake—leading to the nent of the open roaster, or ordinary Tyne

lose roaster furnaces are those now chiefly the Western district and in Scotland, e open furnaces are more generally used in e and Eastern district generally.

nuffle furnace now in general use varies its dimensions, construction, and general a few of these varieties are shown in the s now on the wall, but within the past two very great improvements have been ced into the construction of these furnaces srs. Muspratt, Gamble, and Deacon, who l aimed at so arranging the combustion of l as to obtain in the flues a pressure rather draught.

amble's most ingenious arrangement, gaseous employed, the air for its combustion being l by passing through a nest of iron pipes in the flue, so that the waste heat is to some utilised, while a considerable amount of d pressure is obtained in the flues of the a.

con, on the other hand, obtains the same with ordinary fuel, by sinking the fire-grate depth below the floor line, and taking advan- f the power of the ascending column of fuel This furnace has had considerable success, s reduced very much indeed the leakage h the arch of the furnace, a fault all muffle s are very liable to have.

uch for the close or muffle furnaces. The class, the open roaster or furnace, has n so much improved in its old form. st approved form is that with an iron pan "roaster," the pan being heated by a fire, and in many cases the roaster being h coke, so as to avoid the choking up of lensers with soot.

these various forms of furnace to which I led your attention, the operations are con-y means of manual labour, which is severe n itself, but which is rendered much more amount of acid vapours which the work- to bear with, more especially when dis- the furnaces, and which render it much icult to replace this class of workmen, than almost any other department of an alkali

this cause, the idea of employing mechanical arrangements instead of manual labour was one that very early presented itself to alkali manufacturers, and I have here a drawing of one of the first attempts to carry out this idea, which was tried in or before 1842.

The arrangement of machinery for operating chemical furnaces patented by Pattinson in 1848 was the first real step in the direction of reducing manual labour, and, although it was not so successful as was anticipated, it has helped to show the way to more perfect appliances.

It is true that towards the end of his specification he points out, as regards the usual form of decomposing furnace with pot and roaster, that his apparatus was only suitable for the roaster; but at the beginning of his specification he distinctly points out the application to a decomposing or salt-cake furnace with a single bed, where the salt and acid "are heated, with constant stirring, until the muriatic acid is driven off, and it has become sulphate of soda," and his claim is also clear upon this point. Little more seems to have been done until Jones and Walsh took out their patent in 1875 for a form of furnace consisting of an iron pan of a circular form, which formed the bed of the furnace, upon which the salt and acid were mixed and stirred by scrapers and ploughs, operated, as in Pattinson's furnace, by a central shaft.

The special feature of the patent of Jones and Walsh was a return to the old class of furnace with a single bed, and the doing away with a large amount of the manual labour. It was hoped that this furnace would have been a great success, and a considerable number were erected; but most of these have been, more or less, failures, chiefly owing to the great wear and tear of the machinery, and consequent heavy cost for repairs. Whenever these furnaces have been worked at anything like their alleged capacity, the breakages have been a constant source of trouble, and only when they have been worked lightly have they been at all successful. In some few cases they have been steadily worked for considerable periods without any serious breakdowns, but in these cases there has been great care taken never to overwork them, thus keeping down the heat, and saving tear and wear.

The mechanical difficulties have, it is believed, been, to a considerable extent, overcome in the more recent furnace, patented by Jones and Walsh, in March, 1880, which is constructed almost entirely on the principle of the Mactear calcining furnace, patented in May, 1876, and which is now well known and extensively adopted. But the greatest objection of all to the system adopted by Jones and Walsh—and which holds good equally with the new form of their furnace—is, that the salt and acid being all added within a comparatively small period of time, there is a great evolution of muriatic acid gas at the beginning of the operation, and a rapidly decreasing amount as the process continues. The following figures show the above fact very clearly:—

Furnace charged with KCl.

Commenced to charge at 9.30 a.m.

Do. do. 10.30 „ with vitriol 150° Tw.

Vitriol all run by 1.0 p.m.

First sample, taken so soon as charge thoroughly mixed.

„ „ at 1.30. „ „

Table showing decomposition each hour.

1.30 p.m. contained	24	°/₀ KCl.	= 72·70	°/₀	Decomposed.
2.30 ,, ,,	22	,, ,,	= 75·35	,,	,,
3.30 ,, ,,	14	,, ,,	= 85·13	,,	,,
4.30 ,, ,,	9	,, ,,	= 90·60	,,	,,
5.30 ,, ,,	4	,, ,,	= 95·92	,,	,,
6.30 ,, ,,	3·6	,, ,,	= 96·32	,,	,,
7.30 ,, ,,	2·4	,, ,,	= 97·57	,,	,,
8.30 ,, ,,	1·2	,, ,,	= 98·80	,,	,,

The temperature of the gases entering the condenser, after passing through 300 feet of piping, ranged between 174° Fahr. at 10.15 a.m. to 110° Fahr. at 7.15 p.m.

Great care is necessary in working the condensers when all the acid is required to be high strength, say 30° to 31° Twaddell. The amount of water running into the condenser having to be altered many times during the progress of the charge, a wash-tower of some sort is needed, before allowing the gases to pass to the chimney.

One feature is well worth noting; there is a very considerable reduction in the amount of vitriol required for the decomposition. This, of course, applies to a greater or less extent to all mechanical furnaces, as the mixture of the salt and acid is not only more rapid, but more complete than it can ever be in hand-worked furnaces. The amount of this saving is stated by various manufacturers who have tried these furnaces of Jones and Walsh to be from 4 per cent. to 5 per cent. on the vitriol used. Various other patents have been taken out for mechanical arrangements, but none of these call for much attention, except that form of furnace or apparatus invented by Cammack and Walker, which, introducing as it does a new phase of the question, is well worth careful study. To these gentlemen belongs the credit of first proposing and carrying out the continuous decomposition of salt in a muffle furnace, although the mechanical difficulties connected with their apparatus have as yet proved too much for their complete success.

The apparatus consists of a cast-iron cylinder, about 20 ft. in length, heated externally by a series of carefully-arranged flues, and made to revolve on bearing-wheels. The salt and acid are fed in at one end continuously, and forced onwards by a screw and scraper arrangement, mounted on a shaft which passes through the cylinder, the passage of the materials through the cylinder being also assisted by its being laid with a slight incline (like Oxland's calciner for ores); the finished sulphate of soda is delivered at the lower end of the machine, and, the hydrochloric acid gas being not at all diluted by air or fuel gases, is very easily condensed.

Great hopes of this furnace being an entire success were entertained; but, after a considerable expenditure of money and a lengthened trial, it has been given up, the mechanical difficulties having proved too great so far.

Therefore, it will be seen no thoroughly satisfactory furnace which will produce sulphate of soda mechanically had as yet been introduced, but the question was one that called urgently for solution. On careful consideration of all the various systems proposed from time to time, and believing that a continuous method, such as is indicated in the animal charcoal revivifying process of Norman and others, and applied to salt-cake by Cammack and Walker, was the proper direction in work, I abandoned a series of attempt had made to produce a mechanical muffl and determined to work out the problem tinuous salt-cake furnace on the ope principle.

The conditions with which a mecha cake furnace must comply in order that successful, are much more stringent th case of any of the other furnace operati alkali work.

In designing a furnace the following p be (amongst others) carefully considered vided for, otherwise there is great lik failure and expense:—

1. Simplicity and strength of the n arrangement.
2. Convenient access to all wearing facilitate repairs.
3. Economy in working.
4. Freedom from escape of acid vapou
5. Simple delivery of finished sulphat without escape of acid vapours.
6. Simplicity of arrangements for re of acid and salt.

The experience gained from several yea ing of the "Mactear" carbonating and furnace, which has been so completely in dealing with the question of calcining sc alkali by mechanical means, pointed at o suitability of its general design as a bas construction of a salt-cake furnace.

It required, however, a long period of many abortive designs and plans, ere th details were worked out, so as to give r grounds for belief that all the necessary been attended to, and provided for, and was good ground for belief that the fini nace was likely to be successful.

The furnace, patented in November, shown in the diagrams, has been the res attempt to solve the problem of a mecha cake furnace, and it has been successi general construction is very much the "Mactear" carbonating furnace, being pan resting on radiating arms, which ca ing wheels, on which the furnace rev wheels running on a race or rail, and t being kept from working out of truth by pivot or bearing; the furnace is covered arch, carried on a curb piece, supported of pillars, and the emission of acid gas vented by a lute, which surrounds the ir

The bed, however, of the furnace, di the "Mactear carbonator," in that, instea ing a central opening for discharging th there is a small iron pan or pot, which fi receives the acid and salt as they are fed furnace. The flow of acid is constant, a gulated by a slide and equilibrium valve construction. The supply of salt is int being regulated by a screw, supplied fro per kept filled with salt, the screw being by a ratchet wheel, driven by a connec and a lever and pall, capable of accurat ment as to length of stroke, gears into t so that the amount of feed given to the be governed with the greatest ease.

The salt and acid being continually fe centre pot, this becomes full, and the ex

ıdge into the bed. This may be either in concentric rings or, as in my later without division. As the feed continues, ials gradually work outwards, until the e of the furnace is reached, when the now completely finished, falls down series of ducts into an annular channel, losed by a cover bolted to the furnace ing with it, and which works in lutes so nt the escape of gas; the sulphate, as it his channel, is caught by scrapers, and ıd to a large box or hopper, from which ı out into waggons or barrows.

terials are mixed and turned over by oughs, or scrapers, placed, as in the Mac-ɔnator, between the two flues, through acid vapours and products of combus-ıway to the condensers, where they are to a great extent from the heat.

l of the furnace is lined with fire-brick, tar, and set in a special cement, which be-rder than ever when subjected to the the heat and sulphate, the whole bed ıto one compact mass, which resists very the action of the materials put into the

ating of the furnace may be carried out onvenient, either coke, coal, or gaseous g used; care must be taken, however, rough combustion is attained, so as to oot being passed on into the condensers, ɔt only wasteful in fuel, but apt to stop ensers up.

eat advantage of a continuous plan of de-ıg salt is to be found in connection with ensation. The flow of water need not be or days, as once set for a given quantity nd strength of acid there is little likelihood quiring to be altered until some change ce in the quantities being worked.

is no difficulty in getting all the hydrochloric lensed at a strength of 28° to 30° Tw., with-wash tower, and with an escape in the chim-uch less than the Alkali Act allows. There is weak acid produced, a great point gained furnace of the open principle, and one laces it at once on a level with the close or ırnaces, in which this production of strong ıe is the great advantage. The amount of ng plant also is very much less with the ace, in fact, not so much as one half what found necessary with the close or muffle now in use.

alt-cake, as it is withdrawn, is almost free from smell or acid vapour, and there ce of gas to be seen about the furnace ile working. The appearance alone of the has been found almost sufficient to ıe workmen to regulate with great nicety of sulphuric acid. The results of the f average samples made on each shift for a s Table next column) will show this.

samples were taken by lifting a shovelful h barrow, as it was filled (3½ cwt.), and a small sample was taken from this in the ay, every two hours, and tested. The sults are the average figures for each shift. is no difficulty in making, from common lt, sulphate of 97 per cent. guaranteed, great difficulties which have hitherto pre-

Shift.	Tons made.	Acid (free).	Salt.
1	9·63	1·60	·30
2	8·92	1·25	·65
3	10·33	1·00	·30
4	8·22	1·10	·60
5	9·98	1·50	·40
6	9·62	1·50	·50
7	10·50	1·33	·50
8	8·75	·90	·583
9	10·33	1·25	·40
10	10·15	1·06	·583
11	10·32	1·20	·60
12	9·10	·80	1·40
13	10·15	·90	·50
14	8·23	·75	·60
	Total. 134·23	Average. 1·15	Average. ·565

vented the use of ground rock-salt in the ordinary furnaces altogether disappear with this furnace, as it works rock-salt perfectly, and with it turns out a greater weight of finished sulphate per shift, of a quality which need not contain, at any time, more than ½ per cent. of undecomposed salt.

The quantity of work done depends, to a great extent, upon the draught. In the case of the furnace now at work at St. Rollox (which is connected to a small chimney with little heat in it, so that the draught is exceedingly bad), the work done is about 135 tons per week of seven days—nearly 10 tons per shift; this with common salt, with about 7 per cent. moisture. With a better draught, one ton per hour will be easily finished from common salt with this furnace, which is of 21 ft. outside diameter. Deducting the area of the small pan, and of the outer ring, say 12 in. broad, there remains as a calcining bed about 231 square feet, which, finishing at the rate of one ton per hour, would give about 10 lbs. per hour as the amount calcined per square foot.

The quality of the salt-cake is completely under control; it can either be produced in a fine, powdery condition, suitable for glass-making purposes, or it can be produced in cohering masses, which are more suitable for alkali-making, as, in this form, it is less liable to be carried over into the pan or chimney by the draught.

The sulphate produced is in a condition highly suited for the manufacture of alkali, as it is altogether free from the hard semi-fused lumps such as are too often found in salt-cake made in ordinary furnaces, more especially of the open roaster class. These lumps are very difficult to decompose perfectly in the ball furnace, cause the charge to take a longer time to finish, and are often found as kernels of undecomposed sulphate.

In comparing the relative costs of working the new "Mactear" furnace against the old form, the question of salt-supply is an important element; whether it has to be elevated from the floor level into the hopper of the furnace, or, on the other hand, it can be brought in on the higher level, and be dropped direct into the hopper. In the first case, supposing the salt has to be delivered on the floor level, as happens to be the case with the furnace at present working, then the cost of elevating will be included in the cost of the motive power of the machine.

Assuming, therefore, that in the case of both furnaces the salt is laid down on the floor at the furnace, the actual amount of labour required is, in the case of a Tyne open furnace of most modern construction, furnishing 68 tons of salt-cake per week of six days, three men per shift, or a little more than 11 tons per man per week. In the case of the "Mactear" decomposing furnace, one man per shift is able with ease to do all the work of the furnace, or about 72 tons per week per man, calculated on one ton per hour. In addition for each two or three furnaces, one man is required to look after the engines and oil machinery, and at same time look after the condensers (which require very little attention). In all, the labour may be called $1\frac{1}{2}$ men per shift, or half the number required for the old furnace, while the output, being more than doubled, reduces the actual amount of labour per ton to about one-fourth what it is with the old furnace, the sulphate in each case being drawn into barrows or waggons ready for removal.

The amount of fuel so far has been about 4 cwt. of coke per ton of finished salt-cake; with improved draught it is expected this will be still further reduced.

The actual saving in labour, fuel, &c., after calculating liberally for depreciation of plant and interest, will amount to about 2s. 6d. per ton of salt-cake made from common salt, while to this will fall to be added, in the case of rock-salt, the actual difference in cost of the salt itself.

The effect of such a reduction, when calculated out on the cost of bleaching powder, is sufficiently striking. Assuming that 55 cwt. of salt are required to produce the acid for one ton of bleaching powder, or equal to, say, 60 cwt. of salt-cake, the actual saving would be 7s. 6d. per ton of bleaching powder, common salt being used; with rock-salt, there will be the extra cost of the salt to add to this.

The results and advantages of the new furnace may be summed up as follows:—

1. Greatly decreased cost of the salt-cake produced—say 30 per cent. saved in manufactnring costs.

2. The actual manual labour is much reduced, one-fourth the number of furnace-men being sufficient, while, as they have not to contend with the escapes of hydrochloric acid gas which are met with in the old furnaces, a class of workmen can be employed much more easily dealt with than the ordinary decomposer, who is rather apt to give trouble, and is not easily replaced.

3. The feed of salt and acid being continuous, so is the flow of acid vapour to the condenser; the supply of water can, therefore, be constant, and does not require much attention. The amount of condensing space required is very much less than with the old furnace (about one-half or less), and the acid can all be made of 30° Twaddell if required, without the use of a wash-tower.

4. The quality of the salt-cake is more uniform than that made by the old furnaces, and is completely under control.

5. Rock-salt is worked quite as easily as common salt in this furnace; none of the difficulties which are found in the attempts to use rock-salt in the ordinary furnace, or the danger of breaking the pots, are met with, and the salt-cake is quite as well decomposed; besides, as the rock-salt is free from the moisture present in the common larger output of salt-cake is obtained.

6. Much less ground is required for the of these furnaces, and less roof space is, of necessary, while the whole is easily contr the foreman, whose duties are much more performed than where he has to superintenc of small batches.

7. Should it be considered desirable, a n cal draught can be used, and complete cc tion effected.

A group of, say, six of such furnaces, each of turning out some 150 tons per week of s fed from a high level salt-store by means simple mechanical means as the travelli used in grain stores, which shall deli salt into the service hoppers, the finish cake being discharged into waggons, which run direct to charge the revolving bl furnaces, is what I hope ere long to see at

These would be worked at a very low cc if driven from either one or two main could be worked with one foreman, one man, and eight workmen at most per sh in addition to the economy in cost, th advantage of a works absolutely free fr irritating fumes of hydrochloric acid con the present style of furnace would be obta

I am now preparing plans for such an a ment, and trust ere long to see my ideas out.

DISCUSSION.

The **Chairman** said he had no doubt Mr. would be willing to give any further explanati furnace which might be desired. He should li in what condition the salt and acid mixture wa left the central pot—was it in a fluid state, the decomposition commenced?

Mr. Mactear said the salt and acid came state of mechanical mixture only; little or n position having taken place. It was in very same state as the snow at present in the street a sludge. In reply to a question how the mix moved from the centre to the outside of the pa the furnace was constantly revolving, and the series of stirrers, which turned the stuff over. feed came from the centre, unless it passed c edge, the furnace would get too full.

Mr. Alfred Allhusen asked what was the stirrer; it did not appear on the drawing.

Mr. Mactear said he had not attempted to the details fully, because the invention wa some extent in embryo.

Dr. Alder Wright had listened to the paper w interest, but he should like to ask one or two in connection with the construction of the a more particularly in reference to the scrapers, had almost said were the weak point of the on account of their liability to break and g order. He understood that it was not yet pe that respect, or he should have asked how scrapers would last, without its being nec stop the continuous process for the pu rectifying them, because that was the practi which really limited the continuousness of th Of course, if the works were carried on for only in the week, it would be essential to stop onc and the repairs could be carried out then works where the process was carried out continuously, it would be desirable to have so

as to the length of time the pan could be kept continuously revolving, without the intermixing arrangement getting so far out of order as to deteriorate the purity of the product, by the material balling together in lumps; or for such other differences as had proved disastrous in the case of Jones and Walsh's arrangement. He should also like to ask if there was any possibility of the diffusion of acid vapours underneath the furnace.

Mr. Charles Thomas (Netham Chemical Works) asked if Mr. Mactear had yet had sufficient experience to say what the cost of repairs would be per ton of salt cake?

Mr. Mactear replied in the negative.

Mr. R. C. Clapham congratulated Mr. Mactear on the very able paper he had read. He felt some difficulty in saying much on the matter, as there were so many present connected with the chemical trade who were better qualified to deal with it. They were much indebted to Mr. Mactear for the attempt he was making to bring about a mechanical decomposition of common salt, which they would all agree was what those in the chemical trade had been aiming at for many years. They knew that Mr. Mactear had succeeded remarkably well in both the balling-furnace and the carbonating furnace, and, therefore, they were bound to receive his remarks with considerable respect. The history he had given of the chemical trade, he found rather a difficulty in entering upon it, as he could go much farther back than quoted by Mr. Mactear, for he recollected when salt was decomposed in leaden furnaces, and the many difficulties connected with it. Coming to more practical matters, there could be no doubt at all that the real point for consideration was whether the Mactear decomposing furnace differed substantially from the Jones and Walsh furnace. He recollected several years ago trying a number of experiments with Jones's furnace, and, as Mr. Mactear had said already, when it was worked for some time, the success was really very satisfactory, especially in the condensation of hydrochloric acid.

Mr. Mactear said he must have been misunderstood; he did not think Jones and Walsh's furnace was successful in this respect.

Mr. Clapham said his opinion was that it was very successful in condensation; he was not at all over-estimating the matter in saying that 20 to 25 per cent. more hydrochloric acid could be condensed by the Jones and Walsh furnace, than by the ordinary hand-worked furnace. It was very gratifying to find that Mr. Mactear could condense the hydrochloric acid without any weak condensers, or anything of that kind. He was not quite sure whether he understood Mr. Mactear to give the heats of the gases as they passed from the furnace to the condensers, and from the tops of the condensers into the air. There could be no doubt, however, that whether Mr. Mactear or Mr. Jones ultimately succeeded, what was really wanted was a mechanical furnace to work the salt.

Mr. Allhusen asked if Mr. Mactear's experience showed that any difficulty arose from the action of the acid on the brickwork on the point between the brick bottom of the roaster and the pan.

Mr. Clements thought from what he had heard to-night, this furnace appeared to be the best of any hitherto constructed. It appeared much simpler than Jones and Walsh's, and the centrifugal action produced, by which the sulphate of soda was gradually sent forward and collected, was much superior to anything that had been done previously. The means of collecting the sulphate of soda made it a continuous process, which had not been accomplished before, whilst, as they had been told that, by the analyses of the substance produced, the quantity of acid could be regulated to a degree of accuracy never before attained. If he could carry out the improvements spoken of in his concluding remarks, by which the salt could be continuously supplied in the same way as the acid, it would almost approach perfection. He hoped he would be able to do so, and by that means no doubt the furnaces would be extensively adopted. He should like to know if Mr. Mactear used this furnace himself, and what was the quantity of sulphate of soda turned out. At the present time there were about 200,000 tons annually manufactured, and as this furnace would turn out 150 tons per week of salt cake, it would require about 1,000 or 1,200 of these furnaces to manufacture the whole quantity produced. It was always a difficult matter to get a new invention taken up, however perfect it might be, on account of the expense of introducing new machinery, but if this furnace were a genuine success there was no doubt that in time other manufacturers would adopt it, and the old ones would disappear.

Mr. Gamble said it was of great importance in the salt cake manufacture to make the process a continuous one, and no doubt Mr. Mactear would find there was a great saving in the condensing plant required, and probably also in the quantity of vitriol used. He should also like him to explain his seventh reason for considering the furnace an improvement, in which he said that should it be considered desirable a mechanical draft could be used and complete condensation effected, but he had already said that he could condense the hydrochloric acid completely.

Mr. Mactear said it was condensed to a lower point than was required by the Act, but with a mechanical draught actually complete condensation would be attained.

Mr. C. Lomas asked if Mr. Mactear did not find considerable difficulty in the caking of the salt cake, as it fell from the furnace into the troughs and ducts, because this would lead to a great difficulty in treating those substances in manufacture. It had always been found a difficulty.

Mr. Mactear, in reply, said Dr. Wright referred first of all to the scrapers being the weak point. To begin with, in the case of Jones's and Walsh's furnace, the scrapers and the shaft were the moving part of the machine, and that principle was radically bad, because the very weakest part of the machine was made to bear the greatest resistance, so that it required the shafts to be of enormous strength. In his furnace, scrapers of any form might be used, and he was still making experiments on this point, but those he now used were very much like the ordinary stirrers of the carbonating furnaces. They were small in diameter, fixed at the end of shafts, which came down and revolved in the furnace. They had very small resistance, and the risk of breakage was very small. He did not remember in his experience of carbonating furnaces, any instances of a stirrer breaking.

The Chairman said he had known such cases.

Mr. Mactear said he had never heard of any, though of course they wore away. In the present furnace the stirrers next the pot, which was working in the strongest acids, wore away rapidly, and one about the middle scarcely wore at all, and the one working the edge in the finished sulphate, wore away a little. The quantity of work which could be done with them was certainly very large. For a wear on the end of the scrapers of about 1½ in., they had finished about 1,000 tons. The furnace had only been at work for about seven weeks in all. It had been repeatedly stopped to make slight alterations; and it was only since the new year it had been kept at work steadily. He did not think there would be any necessity for stopping for any serious repair for a long time to come, and a scraper could be put in in three-quarters of an hour. It only need be stopped while the scrapers were lifted out; it could then be started again without it; and as soon as the scraper was ready, and

hoisted up, it might be again stopped, the scraper dropped in, and in about 10 or 15 minutes operations resumed.

Mr. Gamble asked how the scrapers were made to deliver the material to the outside edge of the furnace.

Mr. Mactear said many people seemed to find a difficulty in understanding that; but it arose from this fact, that, there being a continuous flow of salt and acid, and a constant overflow, if the furnace did not deliver the stuff, it would get over-full and choke. But, partly from the centrifugal force, it did not get too full. The delivery of the furnace was absolutely an overflow. That was the principle on which he had worked; basing it on this idea, that, if he fed in the middle, it must get too full and overflow somewhere. They found it to be a mistake to attempt to force the stuff out, because then there was a danger of having the unworked stuff passing over. Dr. Wright also spoke of the works going on regularly for seven days; he did not know what was the habit in Lancashire, but in Scotland, and on the Tyne, they were not in the habit of running for seven days without stoppage. With regard to the corrosion of the iron work, there was absolutely none. The whole of the iron work was painted and tarred; the lute was filled with oil or tar, and there was no escape of gas there at all. The only escape of gas which took place was from the sulphate drawn out from the hopper, and, if it were properly finished, the amount of gas which came off was infinitesimal; in fact, with sulphate, such as was made last week, there was no gas given off. During that week, they had been repeatedly getting the amount of undecomposed salt down to ·1 per cent., and on average of 85 tons it was ·223. The cost of repairs was, of course, a difficult question to answer, and he could not say positively without further experience, but he thought he had discounted that pretty well when he had taken it at double the cost of the carbonating furnace. The only difference was that they had in addition the central iron pot, which did not seem to wear at all, for a hard crust of sulphate half an inch thick formed round it, which apparently protected it perfectly from the acid. All the other arrangements were the same as in the carbonater, except the lute. The wear and tear on the stirrers was of course greater than in the case of the carbonater, but in assuming the repair to be double he made a perfectly fair allowance, because it must be remembered that the carbonating furnaces were doing, possibly, 100 to 130 tons, whereas this furnace would do easily 150 tons, so that if you had double the rate per ton, it more than doubled the absolute amount in money. The lute was made of iron and filled with tar or tar oil. Mr. Clapham spoke of the Jones and Walsh furnace, and said their own machinery much resembled it. His impression was that it was quite the other way. The original Jones and Walsh furnace was the one shown on the drawing, patented in 1875. In 1876 he patented the carbonating furnace, of which the present furnace might be taken as an imitation, except that that was not discharged from the centre. In November, 1879, he patented this new furnace, and in March, 1880, Jones and Walsh patented their new furnace, which resembled this one. The feature of Jones and Walsh's furnace was that they added the whole charge of salt and acid at one time, which he believed to be a radically bad principle, so far as the condensation of hydrochloric acid was concerned. The feature in his was, that it was an open mechanical furnace, working continuously, and giving up the hydrochloric acid in a slow continuous stream, which could be very easily condensed. In reply to Mr. Alhusen, he would say there was no difficulty at all with the joints between the pan and brickwork. After a short time they got a crust of sulphate formed on the whole of the brickwork, the edge of the pan under the bed got covered with a protecting coating of sulphate of soda, which acted very perfectly in protecting both iron and brickwork from corrosion. It was quite true, as Mr. Clements had said, that the centrifugal action assisted the outward direction of the sulphate. He also spoke of ultimately succeeding, and obtaining a continuous feed of salt in the same way as the acid, but that was not absolutely required. They had it practically, for they found, by having a ratchet wheel with pretty close teeth and a pawl which geared into them, and a lever to regulate the number of teeth to be caught by the pawl, which would force it round a given distance at each time, and so give a definite level to the screw which fed in the salt, they got a series of deliveries of so many pounds of salt at a time, which practically was a continuous feed. As to decomposing all the salt in the country, he was afraid that any patentee who should be sanguine that his furnace was going to be adopted by everybody in the trade would find himself very much mistaken. His firm intended to adopt the furnaces themselves, as they believed them to be a thorough success; and, if so, he was quite sure other people would follow. The number that might ultimately be erected was a matter for the future. The saving in oil of vitriol was one on which he could give very few definite figures as yet, because you had to consider the amount of moisture in the salt and the amount of decomposition; but, as far as he could say at present, the saving was about 3 per cent. of sulphuric acid over the amount used in the close furnaces. As to mechanical draughts, the question had been put whether this could be worked in that way. He believed it could, but, if so, the quantity would be considerably reduced, and, as the amount of condensation without appeared exceedingly satisfactory, he did not think it at all likely any one would be anxious to use a mechanical draught. The caking in lumps of the sulphate was a thing they had not been troubled with at all. Sometimes the furnace got into a peculiar condition in which lumps were formed, but they exfoliated and fell down almost to powder when they reached the hot region of the furnace towards the outer rim. The sample shown, which was an average of a week's work, would show that there were no lumps to incommode anybody. In another sample there were a few lumps, but they could very easily be crushed.

The Chairman said they must all feel very much indebted to Mr. Macteur for his valuable paper, and the presence of so many gentlemen from different parts of the country interested in the alkali manufacture was a proof of the interest his paper had awakened. This was another illustration of what seemed to be the revolutionary period of the alkali trade. Some years ago they were under the impression that Mr. Jones had solved the problem in this difficult matter of decomposing furnaces, and they were all pretty sanguine that the Jones furnace would be universally adopted within a few years. Mr. Mactear had explained how these hopes had been disappointed, and that there was still room for the application of enterprise, mechanical skill, and chemical knowledge in solving the problem of an effective decomposing furnace. They must give Mr. Mactear credit for his courage and enterprise in carrying out what he feared must have been costly experiments in striving after perfection. There was no doubt that the continuous process was the thing to aim at; it possessed all the advantages which Mr. Mactear had claimed for it in the regularity of the product, no doubt in economy of material, and certainly in the facility of condensation, because the regular emission of the muriatic acid which had to be condensed was the most essential condition of complete condensation. He should also think it extremely likely that the process would be attended by a saving of acid. This paper was a contribution to a very interesting question which arose in all departments of industry, viz., the limit of the economical application of machinery. Some one had

it would never pay to get a machine to pick ff a field and put them all into one corner; as an extreme case. The real problem Mr. as attempting to solve, was whether this ration to which machinery could be successed. They all wished to replace unskilled machinery, but it did not always turn out ld be done profitably, because there was element of repairs, and the necessity for ll in the working of the machinery. He going to suggest difficulties which Mr. night find in the course of working vention, for he had no doubt he was le of them himself, without any one disn with additional ones. As he had already xperiment was of the greatest value and nd he knew that in another direction they having a similar experiment, because Mr. as attempting a furnace on a very large scale, new principle, to the results of which they look with great interest; and perhaps Mr. rould, at some future time, give them his in a paper. Mr. Mactear's process might be s one in which the batches were of no size at it was continuous; but Mr. Allhusen was ry the same problem, where the batches e on a scale altogether unprecedented, hey would be able to see which plan the best. Meantime, the more cautious or facturers would go on in the old way, keeprer, their minds perfectly open to receive any quarter. He was glad that Mr. Macinteresting retrospect, had given credit to le, the grandfather of the gentleman now r that most important invention, the applieavy cast-iron pans in which to decompose That had held its own, and would continue til Mr. Alhusen or Mr. Mactear showed that better could be attained. Mr. Mactear had the very severe labour of the decomposingn, but his impression was that these men made uch of it; they turned over a smaller quantity for a day's work than any other class of who worked at furnaces, giving as an excuse which they were occasionally exposed. No r. Mactear succeeded in getting a gas-tight at would be an additional recommendation He quite agreed with Mr. Mactear as to ons of successful working, but the degree to were complied with must be determined by If rock salt could be used, that also would vantageous. He presumed it was the longontact with the acid which made the decomrock salt effective, which was not possible in . There could be no doubt about the saving It went rather against the grain to see a man machine, working a heavy rabble, and they ke to see men better employed—they would hem watching a machine than acting as one; ame in the question he had before alluded to it where you could replace brute force by economically with more skilled labour to He concluded by moving a vote of thanks to r.

of thanks having been passed,

tear, in responding, said there was one quesforgotten to notice, viz., as to the condensing e could not give the exact number of cubic y, but they were doing two and a half times the condensers which they could do in the same connected to the old muffle furnace. After all, int was that of repairs, and that could only by experience. He had assumed the cost of double that of the carbonating furnace, and g done that, and having loaded the cost with 20 per cent. on the capital for depreciation and interest, there was still 2s. 6d. per ton to the good. Now, even if we were to assume there was another 1s. of that required for excessive repairs, and it would still leave the furnace economically successful. The Chairman said, "If he could produce a furnace which was gas-tight," but that he had already done, there was no question about it, and the same with regard to working rock salt, for he had shown them a sample of rock salt, abont 100 tons of which had been worked with perfectly good results. The delivery of salt cake direct into wagons for the balling furnace was of course a comparatively simple matter; and when laying down new works it would be comparatively easy to elevate the sulphate direct from this furnace into the hopper of the black ash furnace, weighing it on the way. It was in such a comparatively fine state of division that there was no difficulty in dealing with it.

FOREIGN AND COLONIAL SECTION.

Tuesday, February 1st, 1881; Sir RICHARD TEMPLE, Bart., G.C.S.I., C.I.E., D.C.L., in the chair.

The paper read was—"The Industrial Resources of South Africa," by Sir Henry Bartle Frere, Bart., G.C.B., G.C.S.I., D.C.L., LL.D.

In order to obtain the final corrections of the author, the publication (at his request) has been delayed until next week, when a full report of the paper and discussion will be printed in the *Journal.*

The Chairman, in introducing the subject of the evening to the meeting, recalled to the memory of the members the circumstance that the African Section of the Society was opened, some years since, by Sir Bartle Frere, in an inaugural address, which is printed in the 22nd volume of the *Journal*. He was sure it would be a great delight to all members present on this occasion to welcome Sir Bartle back again amongst them, after the arduous task he had since then had to perform, and that it would also be a great satisfaction to the Society to receive the results of so large a practical experience in the affairs of South Africa, in the form of the paper, which would now be read.

Sir Bartle Frere then proceeded to give an account of the present state of the various districts of South Africa, comprising the old Cape Colony, including Kaffraria, Basutoland, and Griqualand West; the colony of Natal; the Orange River Free State; the Transvaal; and the Transgariep and Damaraland. He spoke of the mineral resources of each section of the land; of the agricultural industries; of the harbours, telegraph lines, railways, and of the recent rapid development of steam navigation; and he finished his address with a special allusion to the condition of the large population of native races that is still spread over the land, and to the necessity which this implied for good and strong Governments over them, if any effectual advance is to be made in the direction of a permanent civilisation for them.

After the reading of the paper, Viscount Sidmouth asked some questions regarding the harbours of South Africa. Mr. Jones exhibited some specimens of the diamonds of the Griqualand districts on behalf of Professor Tennant. Sir Bartle explained there could be no doubt Delagoa Bay was a magnificent harbour, and capable of being connected with the Transvaal by a short line of railway. Sir David Tennant, the Speaker of the Cape House

of Assembly, substantially confirmed the account given by Sir Bartle of the capabilities of the place, and described the extent of country which is already opened out by railways. Dr. Badger wished that it were possible some near neighbours of England, who were dissatisfied with their lot, could be got to understand that there was a good field for prudent industry in the land, described in the paper. Mr. Robert Rawlinson remarked upon the opening out of roads and the peculiarities of indigenous labour. The meeting terminated with a vote of thanks to the author of the paper, which was proposed by Sir David Tennant, and seconded by Mr. Peace.

NINTH ORDINARY MEETING.

Wednesday, February 2nd, 1881; Robert Giffen, Chief of the Statistical Department of the Board of Trade, in the chair.

The following candidates were proposed for election as members of the Society:—

Bridge, John, F.R.G.S., Marlborough-house, Sale, near Manchester.
Cochrane, Vice-Admiral the Hon. Arthur A., C.B., United Service Club, S.W.
Collingwood, Lieut. William, The Limes, Cheshunt, Herts, and India-office, S.W.
Fisher, John, 43, Mincing-lane, E.C.
Hall, William Shipley, 79, Cannon-street, E.C.
Haslam, Alfred Seale, Duffield-road, Derby.
Helder, Augustus, Corkicle, Whitehaven.

The following candidates were balloted for, and duly elected members of the Society:—

Barker, George E., Sutherland-villa, Chiswick.
Barlow, Walter Alfred, 6, St. Paul's-churchyard, E.C.
Buchan, William Paton, 21, Renfrew-street, Glasgow.
Burt, Frederick, F.R.G.S., Woodstock, Crescent-road, Crouch-end, N.
Temple, Sir Richard, Bart., G.C.S.I., C.I.E., D.C.L., The Nash, near Worcester.
Tovey, Major Hamilton, R.E., Waltham Abbey, Essex.

The paper read was on—

TRADE PROSPECTS.

By Stephen Bourne, F.S.S.

It has often been remarked that trade moves in cycles, depression and elevation alternating and succeeding each other at intervals, not indeed of exactly the same duration, but with such approach to regularity that at any particular period we may, with some pretension to accuracy, predict what is likely to follow within a short period of the time at which the observation is made. It is generally found, too, that activity is not confined to one or more countries; but, unless some special cause intervene, that prosperity or adversity pervades the whole trading world at very nearly the same time. The moving cause may originate in one place or in one branch, but it soon becomes more or less diffused; and this will necessarily become the more marked as rapidity of communication and facilities for transport are extended. The duration of these cycles is supposed to ten or eleven years, and, starting with commencement of the present reign—i following upon severe banking and c embarrassments in the United States in ceding year, there was a panic in Londo that 1847, the year of the Irish famine one in which, after the collapse of th mania of 1845, the commercial panic attained its height. In 1857, again, succeeding the Russian War, and that in Indian Mutiny broke out, the Bank Act suspended. In 1866, there was a panic commercial and joint stock companies, th which exercised a fatal influence upon t the three following years; and since the there was severe depression, from which t did not commence to emerge until the 1879.

Between each of these dates there cam of great commercial and manufacturing p producing an inflated condition, to be suc the next wave of depression. It may however, that, as might naturally be the interval between the height of o and the depth of the other has gener shorter than that of the following When once the tide begins to rise, it flow rapid progress, then descends rapidly, a long ebb, or at least a slight flow, event or condition of things sets the c speculation moving, renders everything for a time, and then, having exhausted i collapse ensues. The rise of the last de menced soon after the termination of th German War, in 1871, proceeded with un rapidity through 1872 to 1873, and ha descended much in 1874; but 1875-6 wer deep depression, those of 1877-8, with eight months of 1879, remaining at a very The first indications of revival were o August, 1879; and though there have bee downs—rapid transitions since then— been a well-sustained general improvemen the year just ended, seeming to justify still further progress which may lead greater inflation than any we have before The present condition of trade, and the offers, is the subject with which it is p deal on this occasion.

England is so essentially a manufact trading community that, notwithstand may be distress in other of her intere these are progressing well, the country m to be prosperous; at least, it wears the being so, notwithstanding that, as at the agricultural interest may be sufferin The United States, on the contrary, is so an agricultural nation that, even when t tion of her manufactures is not encoura may, on the whole, be said to be f Therefore, without in the smallest degr rating the importance of our agriculture, of first importance must be given to our which manufactures form an importan Herein lies a real difference between t Kingdom and the United States, that the large trade irrespective of her manufactu the trade of the other is principally in her own productions. British merchant

sing for our own need or selling our own ı, deal with and in the produce of every part world, whilst at present—we do not say ng it may be so—American traders are employed with the interchange of goods she produces for sale, or imports for con- on. Almost everything that is grown or nds a market here, and, what is of immense ance, may be made the means of raising until the state of the market suits for or a sale. It is through this that we are so concerned with the welfare of every land— n their prosperity or are partners in their ty.

e, in the widest acceptation of the term, be divided into two separate branches, the and the foreign—which, though closely ted and greatly dependent upon each other often very differently circumstanced and e a greatly differing influence on the general . The profits of the home trade depend its activity, and they do not add to the of the country as a whole. That wealth, so it arises from home industry, is the surplus ing of that which labour produces, after that the support of the labourers consume is ed. If, as on a former occasion* I attempted ve, every worker does, on an average, pro- wice as much as suffices for his own support at of the non-workers dependent upon him; lf of that which he produces may become bject of trade, and, unless wasted or con- , be so much additional wealth to some Its transfer from hand to hand by the through whom it passes, though profitable or more of these, does not make it the aluable as a contribution to the wealth of tion. Not so with our foreign trade. What- fference of value there may be between an brought hither, and that with which it is paid if on the right side, so much added wealth; y so, in if a permanent shape; indirectly so, sumed in the sustenance of those whose produces something. But, once imported, ding can give it additional value to the y; for, though one man may gain, it is at xpense of another. Home trade is the of acquired wealth, and betokens, by its , the existence of prosperity. Foreign trade, supposing it is not a losing one, is the r of prosperity. For this reason, then, it is ospects of foreign trade which demand the consideration. One more distinction it is ary to draw, that between the trade itself and aders by whom it is carried on. Ordinarily, trade be good, the trader profits by it, but cessarily so. A merchant may purchase a f cotton goods with so much money, expend ch more upon conveying it to a foreign t, and there sell it at a loss. He may have d the proceeds to be expended in purchasing h wheat, which, when it reaches him, may r less than it has cost him, and so make a loss; yet, after all, the wheat, when it , may be of more value than the cotton lly sent away. The country has been a , though the trader has been a loser. It is in or loss which accrues to the country from this trade which it is proposed to consider, not that which pertains to the individual trader.

Again, our foreign trade must be divided into export and import. There is no need here to raise the much vexed question as to which of these it is that best evidences the prosperity of the country. That has been fully examined in a paper on the "True Relation in which Imports should stand to Exports;"* but, in the belief that, in the present condition of the country, it is the exports on which our trading prosperity depends, they will, in the first place, occupy attention. This opinion receives striking confirmation from the following figures, commencing with 1872, admittedly the year in which the inflation of trade reached its greatest expansion, when, also, our exports of British produce and manufactures attained a higher value than any previous or succeeding year has seen, whilst our imports have not progressed in the same sequence. The goods exported, after having been previously imported from abroad, are excluded from both sides of the account† :—

	Exports.	Imports.	Excess of Imports.
	In Million £'s to Two Decimals.		
1872	256·26	296·36	40·10
1873	255·17	315·45	60·28
1874	239·56	311·99	72·43
1875	223·47	315·79	92·32
1876	200·64	319·01	118·37
1877	198·89	340·97	142·08
1878	192·85	316·14	123·29
1879	191·53	305·74	114·21
1880	222·81	350·00 (?)	127·19 (?)

As trading prosperity waned so did the amount of our exports fall off, as it waxed so have they begun to increase. They have not yet reached the level of 1872, but a growth similar to that which has taken place in the last year, would bring the present one up to almost the exact amount of 1872, the decade thus ending as it began.

A somewhat closer examination of these figures is necessary for an estimate of their true import. It would be tedious to go through all the various articles of export, and this having been done elsewhere, the result has been to show that, taking the three great industries of cotton, wool, and iron, the teaching they afford does not differ from that of the whole. It will be sufficient to take the three years—highest, lowest, and last—thus :—

Exported.	1872.	1879.	1880.
	£	£	£
Cotton manufactures	80·13	63·97	75·56
Iron, including hardware and machinery	49·35	29·73	41·08
Woollen manufactures	38·49	19·57	20·60
	167·97	113·27	137·24
Per-centage of whole exports................	65	59	62

With these amounts, it may be useful to compare

* ...ls, Population, and Food." London, 1880. Pp. 114, et seq.

* Same volume, pp. 162-192.

† The tables throughout are constructed in millions to two decimals: thus, for 256·26, read 256·260·000.

the quantities, so far as they are shown in bulk in the published returns, viz :—

Exported.	1872.	1879.	1880.
Cotton piece-goods (yards)	3,535·16	3,724·55	4,496·34
Iron and Steel (tons)	3·39	2·88	3·79
Woollen piece-goods (yards)	384·82	232·90	240·0

This comparison brings out the fact that, whilst the quantity of cotton piece-goods is larger in 1880 than in 1872, by 25 per cent., the money value is actually smaller. For the same years, the price of the raw cotton imported having been in 1872, 68s. 5d.; 1879, 55s. 1d.; 1880, 55s. per cwt.

The tons of iron exported were 10½ per cent. more in 1880, the money value 21 per cent. less, the price of pigs being, in 1872, 102s. 2d.; 1879, 45s. 2d.; 1880, 63s. 10d. per ton.

The quantities of woollen piece-goods had fallen 42 per cent., the money value 46 per cent., whilst the price of the wool imported was—1872, 1s. 2·3d.; 1879, 1s. 2·5d.; 1880, 1s. 1·6d., per lb.

The inference to be drawn from these variations is, that in each class of goods the profits realised by the sale must have been much smaller in the last year than they were in the first of the three periods.

A glance at the values of our imports given above, will show that their amount, in the several years, does not vary with the degree of trading prosperity. In this they differ from the exports, and for more than one reason. For our exports we get the best price we can, and if the markets to which they are sent rule low, we must be content with small profits or none at all; whereas, with the imports, we must buy largely for our own sustenance, and if the prices are high we are compelled to pay them. The supplies of food we need depend much upon seasons of fertility or otherwise at home, but are steadily increasing with the growth of our home population; the whole of which increase must necessarily be thrown upon foreign sources, since we grow less by more than one-half than suffices to feed the existing numbers. Three classes of articles may be selected to illustrate the relation which these bore to the whole, in the same three years as were taken for the exports, thus :—

Imported.	1872.	1879.	1880.
	£	£	£
Articles for consumption as food and beverage......	148·25	173·97	187·20
Materials for textile manu-manufacture	92·40	73·11	84·23
Other manufactures, &c...	50·79	46·81	61·82
	291·44	293·89	333·25

These figures disclose the fact that, whilst our food imports, as between the period of the highest prosperity and revival, 1872 and 1880, have increased 26 per cent., and other articles 22 per cent., there has been a decline of 9 per cent. in the value of the supplies taken for the support of our textile manufactures. But if the comparison be made between last year and its predecessor, i be found that all have increased in the prop of 8, 32, and 15 per cent. respectively.

A point of considerable importance, as re the indications these figures afford of gr prosperity, is to ascertain whether these inc owe their existence to the sale or purchase of quantities or at higher prices. A series of elaborate calculations into the values of 187 1880 give these results as to the exports, th gains in the value is due on :—

	Cotton.	Per cent.	Wool.	Per cent.	Iron.
To volume of exports	£ 9·01	83	£ ·69	70	£ 6·16
To price at which sold	1·87	17	·30	30	2·70
	10·88		·99		88·6

From this it would appear that the addi profit obtained by our cotton manufactures (per cent.) has been, proportionately, far less in our iron or wool, in which the relati volume to value is exactly the same—30 per So with our imports, the additional values i one year over the other have arisen, in—

	Food.	Per cent.	Textile Materials.	Per cent.	Other.
From volume of imports	£ 5·23	40	£ 7·22	65	£ 10·5(
From price of imports	8·00	60	3·90	35	4·51
	13·23		11·12		15 01

Showing that, to the higher cost of our fo owe 60 per cent. of the increased payment, a the other classes only 35·30 per cent. This i portant, seeing that the one is consumed others are, to a considerable extent, recover the prices obtained on the sale of the ma tured goods.

Putting together the whole of the articles have been included in these calculations—be the principal ones that, from the nature of t formation supplied, admit of such investiga it will be seen that of exports, to the va £203·12, in 1880, the excess over 1879 £26·26, of which £18·68 was due to g quantities, and £7·58 to higher prices. O ports of foreign goods, to the value of £3 the excess was £39·36, of which £22·95 from greater bulk, and £16·41 was due to g cost. That is, that for the extra receipts fo ports we had to give 71 per cent. more in qua whilst out of our extra payments for imports 58 per cent. went for additional bulk.

From what has now been said, it is eviden

ıs been, during the past year, a real and ial revival in the export trade of the accompanied by a still greater expansion ports. The real start in both, from the oint of 1879, is really greater than has wn; for the turning point having been in of that year, the gains in the latter hide some of the losses in the former may be shown by altering the period of to which the twelve months are compiled,

	Total Exports.	Imports.
s, ending 31st July..	£214·24 ..	£404·31
,, 31st Dec...	222·81 ..	409·99

proceeding in an attempt to forecast the rogress of our foreign trade, from the evi- fforded by the past, and especially the ast, it may be well to inquire somewhat condition of the home trade; premising facts being much more difficult to ascertain, lts they give are inferential rather than

extent to which cotton has been manu- for home use in the three several years, it le to form a tolerably correct judgment. ucting from the weight imported the es exported in the raw condition, and then ing at the generally accepted rate, of five the lb., we can guess at the quantity that ing the year, been absorbed in the manu- of goods for domestic consumption. Thus—

	1872.	1879.	1880.
	cwts.	cwts.	cwts.
on imported	12·64	13·17	14·55
ton exported	2·43	1·68	2·01
l in this country..	10·21	11·49	12·54
iece goods exported	6·30	6·60	8·00
d thread	2·—	2·20	2·—
	8·30	8·80	10·00
for home use	1·91	2·69	2·54

is thus reason to think that the home cannot have been greater during the past n in the previous one, though both con- y exceeded that of 1872.

gards the progress of woollen manufactures, not able to calculate so closely, but some tion is afforded by the quantities of the raw l imported and exported.

	1872.	1879.	1880.
	lbs.	lbs.	lbs.
ported	380·80	500·20	568·37
yarn exported....	184·91	292·40	281·02
for use	195·89	207·80	287·35

ot possible to estimate the weight of wool d in the manufacture of the goods ex- but as these, in 1880, have not, in the ceeded those of 1879, by so large a pro-portion as the raw material retained for use in the latter years has done; there is room for supposing that there has been a greater consumption at home, although the trading reports scarcely bear out this supposition.

Coming next to the iron industry, the raw material for which is principally of home production; we find that the impetus given to manufacture for export, has induced a more than corresponding increase in the number of furnaces put into blast, and hence the manufacture of a larger output. It has been estimated that the quantities may stand thus:—

	1872.	1879.	1880.
	tons.	tons.	tons.
Pig iron produced..............	6·74	5·99	7·20
Importation of iron ore	·80	1·08	2·63
Exportation of manufactured iron	3·39	2·88	3·79

It is generally admitted that the stocks in hand are larger than they were last year; and, if so, it is difficult to see how there can be such a greatly increased demand for home consumption as is supposed. There can, however, be no doubt that the additional number of ships known to be on the stocks, or recently off them, must have required more iron for their construction. It is significant, too, that the exportation of iron in December last was some 22,000 tons less than in the same month of 1879, and that the stocks in bond in the United States, which has been our best customer of late, are greater than they were.

Another feature, which is generally and rightly taken to indicate the briskness of trade, is the amount of railway traffic receipts, which, as published, have during the past half-year amounted to £226·27, being an increase of £1·01 on the corresponding period of 1879. This, however, must not be attributed wholly to the home trade, for the carriage of goods, especially iron to the ports of export, and the transport of grain from the ports of import, will have added largely to this extension of traffic.

The London Clearing-house returns again are evidence that something which is worth money is passing from hand to hand. Yet this may not be so much from trade in goods as from speculation in funds, stocks, and shares, as may be inferred from the very large figures of settling days—1879, £4,859· millions; 1880, £5,716· millions.

Any review of our trading position, or attempt to estimate its progress during this or following years, must be incomplete if attention be not paid to the state of our finances. The low rate of interest at which money is to be lent, and the high price at which Consols or other stocks are to be sold, may evidence either that trade is so profitable as to provide large surpluses for investment, or so contracted as to leave little room for the employment of capital already acquired. As a rule, however, when trade is brisk, money is dear, and cheap in times of limited employment. This has been and is the case in the last and the present years, and the gradual hardening of the market induces the belief that money is now finding employment in trade rather than in fixed investments. Yet, it will not be safe to rely too much

upon this as evidence, for, with increasing facilities for interchange of money securities and credits, the plethora or scarcity of available money in this country may be affected by circumstances other than those of trade, at home as well as abroad. An attentive survey of the state of the money market, as evidenced in the Bank rates, the stocks of bullion held by the Bank, the prices of the public funds and other securities yielding a fixed income, at the different periods of our commercial history, cannot fail to throw much light upon our trading condition at the present moment, and its probable progress in this and following years. But this subject is so much complicated by the operation of political movements in other countries as well as our own, and influenced by a variety of other causes, into which there is not time now to enter, that it must be passed somewhat lightly over.

The mere fact that money is plentiful or otherwise in New York, Vienna, or Paris instantly acts upon the available supply in London. Nor is it possible at all to ascertain where the money employed in any one trading or mercantile centre is really owned. Thus, English mercantile bills are constantly discounted in Paris and *vice versa*, just as the current rates of interest in the one place or other may make the process easy to be effected; and purchases of English funds or stocks may be made on American account without any movement of either bullion or goods. There is reason to believe that, during late years, when the balance of trade between England and the United States was increasingly against us, American securities held in England were largely bought back in payment for our excess of imports; and, though now it is stated that very large purchases of American railway and other stocks have been made here by *bona fide* investors, it is difficult to see how the purchase-money has been transmitted to the other side of the Atlantic; seeing that a comparatively small amount of bullion has been sent over, whilst our obligations for imported food have been very large. Judging by present appearances, it would seem that there is no lack of money for trading purposes, or for increasing means of manufacturing articles for export, but very little disposition to put it fully to such uses; thus evidencing very little confidence in any great expansion of trade being about to arise.

Too much stress has been laid upon the great rise in the prices of all public securities, which is variously stated to have been 15 and 17 per cent. within the year, equaling upon three to four thousand million pounds sterling—the estimated amount held in the United Kingdom—an addition to capital of 450 to 600 millions, and this is spoken of as though it rendered the country actually more wealthy. No one really believes that the country's wealth has thus increased. An individual holder, or even a number of such, seeking to realise investments, may now do so to an advantage; but let the whole, or even a large number of such holders seek to turn their stocks into money, and prices would immediately recede. Yet this nominal growth of wealth is, to a great extent real for trade purposes. Bankers and others will lend on such securities more when they are high than low, or, at any rate, their owner can obtain more credit with which to traffic. It is this credit that creates so many fluctuatio[ns in] trade. A belief arises that more goods wi[ll be] required for exportation or consumption, [and] forthwith purchases are made, in the expec[tation] of selling again. Prices go up, as willing [buyers] increase, until it is found that the real dem[and is] small, and forthwith there is a rebound. Th[is has] been evidenced in the transactions of 18[..]. Orders came from America for iron, princip[ally in] the form of rails, or pigs to make rails; prod[uction] was increased; prices went up, then fell, a[nd] have partially risen—to fall, it is probable, sti[ll] when it is found that the demand has sla[ckened] or ceased. This demand really arose fro[m two] causes: the excessively low figure to whi[ch] prices had fallen, and the lamentable de[ficiency] in our late harvests, which rendered lar[ge pur]chases of grain necessary. The ready sal[e] American agriculturists found for their p[roduce] induced the belief that extended cultivation [would] be profitable. To do this, additional rai[lways] were necessary, and, our rails being cheap, [they,] instead of money, were taken in payment. [This] saved us from the expected drain of bullion [for] the time, and, should our harvest this year p[rove] good, may save us from it altogether. If so, [the] anticipated expansion of trade with the U[nited] States will not go on for any length of t[ime.] Other causes have acted in a similar manner [in] other branches of trade, as evidenced in the fol[low]ing figures, showing the destinations of our [na]tional exports during the twelve months e[nding] 30th September last, as compared with the[exports] to the same countries in 1872 and 1879.

Value of Exports.	1871-2.	1878-9.	18[illegible]
	£	£	
To United States	40·53	16·30	[illegible]
,, British India	22·37	23·64	[illegible]
,, China and Japan	11·34	9·28	[illegible]
,, all other countries	173·02	138·32	1[illegible]
Total	247·26	188·04	2[illegible]

Thus the increase in our exports in the one was:—

	£			
To United States ..	15·19	=	90	per cen[t.]
,, British India ..	7·51	=	32	,,
,, China, Japan ..	3·05	=	33	,,
,, Other countries	4·59	=	3	,,

The similar figures for the year ending Dec[ember] last, are not yet published. The total, how[ever,] for the year, as found in the monthly retu[rns, is] £222·81, or £4·43 above that for the twelvem[onth] ending in September, that being the excess o[f the] last quarter of 1880 over that of 1879. The l[arger] portion of this excess will, probably, be fou[nd to] be to India; and some to Australia and Ca[nada,] with whom our trade has been little of [late.] Yet, even when this is added, it will still be [seen] how limited has been the area of enlarged ex[ports.] The "other countries"—that is, all the worl[d be]sides, America, India, China, and Japan—t[aking] from us 143 millions out of 218, have n[ot, at] furthest, increased their purchases by more [than] 5 or 6 per cent. Nor does this represent g[...]

trade, since the general rise in prices will account for some 4 per cent. of the additional value, leaving the quantities of the goods much as they were before. With one-third of our customers we have done better business in 1880; with two-thirds it has remained stationary, even during the recent expansion; whilst, as compared with 1872, it has been worse, by from 20 to 25 per cent.

These are serious considerations as regards the anticipations which are to be formed for the future, and should enforce the utmost caution in all trading and manufacturing engagements. Yet it is to the newer countries, those which have not yet become peopled, or, if peopled, where arts, manufactures, and commerce have yet to be introduced or developed, that we must look for any permanent or profitable increase of trade. It is to these we should send our capital and labour, if we would make new markets or raise up new customers.

History, it is said, repeats itself, and if trade prosperity is to proceed as in former times, the cycle must be near its end, and the advent of its highest be at hand. It is necessary, therefore, to study the course of the past fall and rise, that we may know how and when we may expect its completion. ch also would seem to be the general expectation of all who are engaged in trade. Most of the circulars issued at the commencement of the year speak of the past 12 to 16 months as those in which there has been much fluctuation, but withal a growing improvement which promises to become fully developed in the months or years soon to follow. The late depression has been longer than its predecessors, and from this it is inferred that the revival will be more rapid. But such repetition seldom or never is complete in all its features, and it may be well to look also at the points in which the present condition contrasts with that of the years during which the last flood was running.

In 1870, the exports of British produce and manufacture rose but ten millions; in 1880, they increased more than thirty; whilst the imports retained for home use, in 1870, were only swelled by the same ten millions, whereas in 1880 the addition has been to the extent of forty-five millions of money. The total imports retained may be thus divided:—

	1870.		1880.
Food................	100	..	185 (?)
Raw material........	119	..	120 (?)
Manufactured	40	..	45 (?)
	259		350 (?)

In 1870, our imports exceeded our exports by £59 millions, in 1880 by 127. In 1870, we had had in succession three of the best harvests ever known; in 1880, with one exception, six of the worst. In 1870, the population which produced our 200 millions of exports, and consumed the 100 millions of foreign supplies of food, was 31 millions; in 1880 will probably have numbered 35 who were only able to export 222 millions, whilst consuming 185. In these respects the condition of the country was widely different from that of the present time, and seems impossible that trade should run the same course.

Again, 1870-1 was the year of the Franco-German War, which—whilst it rendered both countries in large measure dependent on this to supply their wants—paralysed their own trade, and lessened their powers of production. Now, ten years of peace has enabled both of them greatly to increase their trade, and that in many articles which rival ours. America was scarcely beginning to recruit the resources wasted in her civil war. Now she is entering upon a competition and race with Great Britain, the keenness and fierceness of of which promises to exceed the wildest expectations which could have been entertained ten, or even five, years ago. The power of supplying the wants of the world has increased in greater degree than those wants have grown, or rather than the means of paying for their supply have expanded; and we have not preserved our relative superiority in producing power.

To take another view of the case; in 1870, we were at peace with all the world; we have now to meet the cost and overcome the disorganisation resulting from contests in India and the Cape; from the decay of the Turkish Empire, the trade with which was, to us, formerly, a source of the greatest profit; and, however soon the condition of Ireland may change, there can be no doubt that its present state is entailing losses which must have an effect upon our commercial progress.

All these considerations should check any exuberant hopes that the inflation of 1872-3 is about to be revived. The progress already made during the past year has been very spasmodic. Of this no surer token can be adduced than the fluctuations in the price of iron, the article of our trade with which the revival commenced, and on the continued demand for which much extravagant expectation has been based. It is but too evident that speculative action drove the prices of this and other things far higher than the extent of the trade in them warranted; and though at present prices may be at a fair level, they are not so high as to yield great profits. Any permanent increase in cost or selling price would, in all probability, put a check to demands which, there is reason to believe, grew out of exceptional circumstances not likely to exist for any length of time.

It is the undue influence of this speculative element which threatens to revive the fatal inflation of 1872-73, for though during that period there was much real accession of wealth to the country as well as to individuals, there was still more that was false. Since then, and as the result in great measure of the course then pursued, there have been sad and heavy losses; not solely to the wild speculators the cessation of whose butterfly term of prosperity there is no reason to deplore. In such seasons the hard-earned savings of the prudent and careful, the provision made for widows and orphans, become placed in the hands of financiers, who unduly stimulate trade, only to prepare the way for renewed depression, and for all the misery which such catastrophes as the Glasgow and West of England Bank failures inflict upon the undeserving sufferers. Yet, altogether undeserving many of those who suffer can scarcely be said to be. It is the speculative spirit which seems to possess so many of all classes, that opens the door for those who thrive by its existence and cultivation. Since 1872, the number of these, and the boldness of their flights, have vastly increased, and it is painful to see how constantly the writers on trade subjects speak of speculation, as though it

were the legitimate basis upon which the expansion of trade is entitled to rest. To judge by present indications, if trade does so rapidly revive, it will have very little firm ground upon which to stand. There is really nothing more solid to justify the extravagant anticipations so generally formed—nothing more likely than this speculation to wreck the prospects which may be safely entertained, that a gradual, though slow, improvement may be maintained.

What, for instance, are the prospects that our trade with America will, next year, exceed that of the last? She found us in want of increased supplies of food, owing to our bad harvests; and from her extended agriculture supplied our wants. She found, too, that our iron trade was suffering great depression, that prices were so low as to permit importation into her country profitable, even under prohibitory duties (levied as such, more than for revenue purposes). We purchased her corn at good prices, and paid for it with iron, sold at the outset at poor prices. Believing that this state of things permitted of continuance, and flush of means from her profitable exports, she determined to lay down rails, to enable cultivation to be extended further inland; thus taking off our hands accumulated stocks, and even new supplies, at prices which became, as they went higher, the stimulus to further production. Unless, however, in the meantime, new openings for trade can be found, it is not at all probable that this will continue. A good harvest at home, should we have one this year, will leave much of the grain now growing for our market as surplus stock in the hands of the Western growers, and thus prevent the continuance of the purchases from our manufacturers which has had so much to do with sending prices up. Should this be the case, it may, in the end, not be disadvantageous to us, for so soon as agricultural production in that country exceeds the demand, or from other causes prices fall so as to be less profitable, the growers there will become unwilling to protect, their various manufacturing interests, at an excessive cost to themselves, and thus bring about the reduction or abandonment of prohibitive or excessive duties. This is the direction in which we may look for the growth in America of free-trade principles, the establishment of which must, sooner or later, be consummated. This may, for a time, be allowing our manufactures to come into competition with her own; but the progress she is making in the neutral markets of the world forbid the hope that she will long allow us to hold our ground where our products have hitherto predominated, still less increase her internal consumption of those imports which she has in herself the power of producing. The figures already quoted show that our exports thither are not on the increase, and when the next quarterly return of values appears, it will probably show that the trade with her in our own manufactures has already begun to decline.

If we turn to India, the country which, next to the United States, has contributed most to the revival of our export trade, the prospect is more hopeful. Yet, even there, the recent exports must be deemed exceptional. During the famine, her power of purchasing was limited; much that has been sent there during the past year has been to supply previous deficiences, and it is understood that stocks of cottons are accumulating. Two-thirds of our exports thither consist o[f] manufactures, and though it may not be f[or] time to come, it is not probable that Ind[ia] the raw material on the spot, and with la[bour] much cheaper than here, will, any mo[re than] America, fail to manufacture for herself. [There is] greater likelihood of her requiring larger [supplies] of iron to extend her railway system, tho[ugh this] must come slowly; but the capitalist wh[o would] now erect cotton mills with the intention o[f manu]facturing more largely for Indian custome[rs would] be guided more by faith than reason.

The third principal quarter from when[ce] orders for our manufactures have come is Ch[ina and] Japan. Here, again, far more than the ha[lf of the] goods these countries take from us are c[otton] pieces and yarns—a trade which is likely [to con]tinue, and may greatly increase. At prese[nt there] seems little opening for selling them iro[n in] quantity, but so intelligent a people are sur[e, ere] long, to see the advantages of railway comm[unica]tion; and unless we are beaten out of the [field] by our neighbours in Belgium and German[y, there] is every reason to anticipate that these peo[ple will] prove extensive customers. There is no ab[surdity,] however, in the belief that when that day [comes it] will be accompanied, or preceded, by such an[influx] of the Chinese labourers as may seriously [compete] with our own workers, in our own places [of pro]duction.

It is exceedingly unsatisfactory to find [that the] Australian colonies have contributed litt[le to the] recent growth of our exports. Canada [has done] much better in 1880; but then 1879 wa[s a year in] which she fell off in her demands for ou[r goods.] There seems but little reason for hoping [that any] great extension of trade to these colo[nies will] speedily take place. The South Afric[an trade] must receive a severe check—excepting [in the] necessaries expended in war—from what [is now] is, taking place there.

So far, then, as the present outlets for [the pro]ducts of our mining and manufacturing in[dustries] are concerned, there would appear to be ve[ry little] solid basis on which to hope for any grea[t expan]sion of our trade in the present or comin[g year.] It may even be that the revival has rea[ched its] height, unless wild speculation attempts to f[orce] goods on markets in advance of their requi[rements.]

It will be gathered from what has b[een] said, in connection with his previous expre[ssions of] opinion, accompanied by copious compil[ations of] figures, that the writer sees but little to [admire in] the rapid extension of the import trade; [and that] he sees nothing to regret in the fact wh[ich this] month's official returns manifest, that [its ex]pansion has received a check. The figure[s of the] coming year will possibly prove this to ha[ve been] something more than accidental or tem[porary.] Without again going over the ground [so often] trodden on former occasions, it may now [be fair to] say that he sees no reason to doubt the so[undness] of two arguments, which he thinks the h[istory of] the past decade should remove from the r[ealm of] controversy—namely, that a continued g[rowth of] imports, unaccompanied by a corresponding [growth] in the exports, cannot be an evidence of [increas]ing wealth; and that it is by no means sati[sfactory] to find that the whole value of our exp[orts, de]ducting the cost of foreign materials whi[ch]

ir manufacture, now falls far short of the e have to pay for the food which our in- g population requires for its support. Further, long as our increasing population fails to itself over the unoccupied and uncivilised which lie ready for cultivation; and continues esent wasteful expenditure of substance, ; and life, the prosperity of the country s the expansion of its export trade far d the present bounds, or those that seem to its reach. With one other remark, he would ; his already too extended paper to a close. his, that for such expansion the fullest m of trade is absolutely essential, and hence, y attempt to fetter it with the shackles of city, or to crush it under the dead weight ation, would be fatal to the continuance of le on which, under present conditions, our as a nation depends.

DISCUSSION.

el Hill said he should have liked to have heard 's criterion of value. His experience taught e prices put down at the Custom-house were the cost, or mercantile price. He would nt that the import values were inclusive of ile the exports were not. He remembered ipments of rails to the American markets, ices realised, including an *ad valorem* duty, of the price obtained by the English mer- lid not agree that the large exports of rails to d been principally paid for in cereals, for, stances, he believed they were paid for in railroad and other securities. These were be borne in mind in determining our with America. The late activity in this tributable to the facts that the price was nd that iron-masters were so desirous of heir trade, that they took securities, which, ments, they would not look at. A very im- stion, which had not been dealt with, was our. There were two giant forces, capital and if they opposed each other the danger t as the collision between two steamships ess trains; yet sufficient attention was not ing up good relations between these two was the dignity inherent in labour suffici- ised.

lius Walford was glad to find Mr. Bourne, ree, more hopeful than he had been in the ad been accustomed to think that if trade again revive, but become worse, Mr. Bourne been one of the greatest men alive, because he predicted it, but now he feared his fate would that of Goodwin the astrologer, who pre- urning of London, but he was so much ridi- ring done so, that he denied having made the ly a few weeks before the great fire occurred. lford) thought there were decided indications ent in trade; but he was not at all sure that sun-spot theory had not misled a great many was quite true that, looking at the history of r the last century and a-half, there were re- iods of expansion and depression, and the lways been accompanied by predictions such made. About 1819, the agricultural interest l to be as much depressed as it was now, and it would never recover, but while it did re- s disposed to think that it was in a worse state was then. There was no doubt that America at rival of Europe with regard to agricul- ce, and it must be so. It would be a bad rice, if our harvests were more productive. om details, the general question was this—was it possible, with the vast ramifications of trade, to bring together in one focus all the circumstances which went to make up the greatness of a nation? He thought not. With all the skill and knowledge that even Mr. Bourne could bring to bear on the question, he did not think it was possible to truly forecast the future. And it was well it was so, or speculation would be more rife even than it was at the present. When he saw these great periods of expansion, when the exports approached or exceeded the imports, he did not consider they were the periods of greatest prosperity, but rather the immediate precursors of panics, when the fruit of the speculation of the past was becoming ripe. He hoped, therefore, that, taking a lesson by the past, whatever trade was doing now would be done with safety, and then, if individual or even national profits were smaller, the progress made would be more secure. They would then have an honourable trade, and one which was good for all concerned in it. The thing required, in his mind, was steady progress, and he was quite sure that the discussion of these questions by Mr. Bourne, the Chairman, and others had done good. The problem had been considered all over the world, and though some of the colonies were taking a course with regard to protection which they at home might think wrong, still there were two sides to every question, and the colonies which exported so much raw produce might be justified in taking a course which, to us in England, who imported so much, might seem wrong. No man could safely predict the future in these matters, for he must bow to the force of events.

Mr. Christian Mast thought there was a contradiction in the paper between theory and practice. The practice, as carried out in the figures, was excellent, but the theory at the beginning seemed to be that of cycles, which was not trustworthy. All the circumstances of trade must have causes, and in his opinion the causes were terrestrial only, and had nothing to do with the sun. If Europe was prosperous, it must result either from good harvests, or from the state of affairs and society. He thought periods of prosperity could always be traced to public tranquility, and bad periods to a disturbed state, social or political. Nothing appeared to him plainer than that in 1871 England was prosperous because France and Germany were depressed, and so in other periods.

Capt. Bedford Pim, R.N., said he must join issue with Mr. Bourne as to the last part of his paper, wherein he deprecated reciprocity and protection. If any one looked around, at the results of free trade, he must feel unbounded astonishment that any one had been wild enough to follow such a Will-o'-the-Wisp. There was not a nation on the face of the earth which had followed Great Britain in this respect, and they could hardly suppose they were the only people in the world who knew what was beneficial. Take the United States. In 1869, they owed £551,000,000; but, in ten years, they had paid off no less than 128 millions sterling, and were now progressing by leaps and bounds, whilst England had only paid off 10 millions of debt since the Queen's Accession. Free trade was to have given cheap food, but Mr. Bourne had admitted that provisions were dearer all round than they used to be. He would at once put a duty of 5s. a quarter on corn, which would produce five millions of revenue, and would only increase the price of bread 3d. on 14 quarterns, while it would enable the English farmer to live. Mr. Read told him that it was impossible to grow corn in England under 40s. a quarter, whilst the Americans could lay it down here at 38s.; so that a 5s. duty would equalise matters. Again, in his own profession, it was most important that we should have grain brought in our own ships, but, owing to the repeal of the navigation laws, 80 per cent. of our seamen were foreigners. He was not going to run down foreigners, and the Russian Finns made splendid sailors, but suppose there were a war with Russia,

they would not bring grain cargoes to England. Corn would, in such a case, no doubt, be made contraband of war. A Bill had just been declared urgent in the French Senate for giving bounties to French shipping, and no doubt it would very soon become law. What was England going to do then? Her sugar industry had already been ruined, and 20,000 men thrown out of work by the French bounty system. Steam and telegraphs came into being soon after the free trade system, and soon after came the gold discoveries in Australia and California, and these things caused an expansion of trade, but that was a very different thing from extension. In conclusion, he expressed his opinion that there was never a more complete piece of humbug than free trade.

Mr. B. Francis Cobb said there could be no doubt of the value of the paper, whatever criticisms might be made upon it. He himself should be inclined to criticise some portions of it, as, for instance, where the author said that when a thing was once imported into this country it did not alter its value the more it was manipulated; but if that manipulation consisted of labour expended upon it, and was then re-exported, there was certainly a gain to that country. There was no doubt a great deal to be said on the question of freight, as bearing on the value of exports and imports. The value of money as an importing power was less than it was, and the same quantity of money did more work now than formerly, owing to telegraphic communications. If he wanted to import seeds from India, he had only to give security to an English bank, and he could telegraph out a credit to his agent in India, who could purchase what he required at once, so that an immense amount of the capital which was formerly required to carry out such operations was saved. By this means a much smaller per-centage of profit would repay the merchant, because much less capital was required than in days gone by. All this made it more difficult to forecast the state of trade for the future. When a want arose it was immediately supplied, and there was not the same opportunity for speculation. With regard to Captain Pim's remarks about the colonies and free trade, he would recommend him to compare New South Wales and Victoria. The former, which was a free trade colony, was fast outstripping Melbourne, which was saddled with high protective duties. With regard to foreign sailors, though he had not the statistics at hand, he was convinced there were as many Englishmen under the British flag as there were 30 or 40 years ago; there were certainly as many British subjects.

Mr. Liggins said Mr. Bourne deserved their thanks for the able and exhaustive paper he had prepared, but he was surprised at the conclusion arrived at, to which Captain Pim had already referred. The author had given figures which he considered most disastrous for the future of English trade, and he had stated most truly that the growth of imports, unaccompanied by a correspondent increase of export, could not be considered as evidence of increasing wealth. He (Mr. Liggins) read in the *Times* that morning that one of the largest steamers belonging to the Steam Navigation Company, the *Libra*, had been in collision in the river, and she was going to Hamburg in ballast to fetch a full cargo of manufactured goods for this country, and he did not see how that could be a transaction for the benefit of England. He had always understood that they lived by what they sold, not by what they bought. He was a West Indian proprietor, ruined by free trade, which he could not too strongly denounce. Another thing he saw in the *Times*, was the loss of an English ship, bound from Demerara to New York, with a cargo consisting of the produce of English colonies, intending to return from the United States with a cargo of manufactured goods. How could that be to the advantage of England? He had in his hand a West Indian newspaper, in which three out of four of the advertisements were from New York traders. One third of the crop of Antigua [illegible] year to New York. All those islands were [illegible] their sugar to America to be manufactured, [illegible] only came to England which was mortgaged t[illegible] merchants. He was a shipowner, and th[illegible] part of the sailors he had to employ were f[illegible] and he feared that, in case of a war, we shou[illegible] difficulty in getting men to man our ships and [illegible] battles. Mr. Bourne's figures were black en[illegible] he did not think they were as black as the re[illegible] could corroborate what Captain Pim had [illegible] French shipping, for only lately a French no[illegible] told him that France intended to do all the t[illegible] world, and to drive England out of the market. But [illegible] was a worse feature even than that, for there w[illegible] agitation going on in America to subsidise [illegible] ships, in order to drive the large English [illegible] the line. He held shares in one of the largest [illegible] ship companies, which last year paid no divi[illegible] he knew of one Liverpool vessel which lost [illegible] one voyage. This could not go on. If Eng[illegible] her ships, her colonies, and her commerce, the [illegible] would soon be much worse than any Mr. Bou[illegible] given. He did not think it was fair to c[illegible] 1879 and 1880, because accidental circumstances [illegible] show an improvement in one year; the com[illegible] ought to be made with 1872. With regard [illegible] sugar industry, he considered it a great mi[illegible] take the duty off sugar. It produced five mil[illegible] revenue, and gave the working man an opport[illegible] contributing something to the revenues of a [illegible] which gave him such high wages. Working men [illegible] beginning to see that a free breakfast table was a [illegible] take, and meant low wages. The working [illegible] should rather make the things they manuf[illegible] higher in price, and then they would get good [illegible] nine-tenths of them were now beginning to s[illegible] free trade brought them low wages. In the Ken[illegible] Town-hall £10,000 worth of Belgian iron was em[illegible] and in the Albert-hall, £70,000 worth, and th[illegible] certainly no benefit to the working classes. The [illegible] showed they were importing more than they [illegible] exporting, which must mean ruin in the end.

Mr. Pfoundes said, when he was in Japan and [illegible] he had many opportunities of mixing with the [illegible] and looking at trade questions from the native [illegible] view, and the result of his experience was that [illegible] the most crying needs for successful English co[illegible] was more competent agents. For want of these, [illegible] portant work was committed to natives, who, of [illegible] used the information they obtained for their own [illegible] Again, the old-fashioned system of English trad[illegible] was on far too expensive a scale—a greater part [illegible] time of the agents being spent at the club, [illegible] full-dress dinners—the consequence being that [illegible] charges were out of all proportion to those inc[illegible] the more thrifty of our continental competitors. [illegible] in the consular service, young men, admirably [illegible] in many respects, were sent out, but they w[illegible] allowed to engage in trade; they knew nothing [illegible] matters, and could not compete with the repres[illegible] of other countries. He could not agree w[illegible] criticism of a previous speaker, that Mr. B[illegible] figures were not trustworthy.

Mr. Hill asked if Mr. Bourne could give an [illegible] the present purchasing power of money, as co[illegible] with 1826 or 1828.

The Chairman said that though the discus[illegible] been interesting, it had to a certain extent be[illegible] cursive, one or two sentences in the paper [illegible] led into a discussion of the principles of free [illegible] He should not go into that question at any [illegible] because, notwithstanding what had been [illegible] should assume that the majority of those p[illegible] and at any rate the Society, as a whole, were [illegible] freetraders. He must remark, however, that no[illegible]

ng all the predictions which had been made as to ils which would follow our free trade system, ain had been very long in coming, and he was red to maintain that, at the present time, there no country in the world, not even excepting the d States, more prosperous than Great Britain, or e such a large mass of people had employment at wages, and had so fair an opportunity of enjoying a health and comfort. With regard to foreign tries imitating our free trade policy, he might re- t that if they were at all logical, they would y their protective system much farther; the ed States, for instance, should not only have a against foreign countries, but New York should a tariff against Massachusetts, and so on, so as to utmost benefit from the protective policy. There the smallest foundation for the statement that men had been thrown out of employment in the industry; at the present moment there was more eing refined in the United Kingdom than at any eriod, and if there were fewer people employed, it ng to improvements in the mode of manufacture. here were foundation for the statement, it would r that the less employment was due to the bounties the foreign Governments, and this question had n faced by those who had been promoting the against the sugar bounties. Coming to the lf, he should like to say that, so far as he could though it was a little less gloomy in its state- in some former papers by Mr. Bourne, still, on , there was a tendency to too much gloom, e facts and in the anticipations put forward. nce, in speaking of the iron trade, he threw the suggestion that the home consumption had Now he had occasion, some time ago, to what narrowly into the figures, and satisfied at from October to the end of December, there an increase of something like 25 per cent. me consumption of iron; for although the ipments had decreased, the increased stock, ed with the same period of last year, was very that the immense increase in the production been nearly all absorbed in various manu- it home. With regard to the cotton trade, ne said that stocks were supposed to be accu- in the East; but, as far as he could discover e circulars, those stocks were extremely well into consumption. Another fact, from which l to draw a gloomy conclusion, was, that last was no increase of exports to Australia; but ected very well, that two or three years n our exports to foreign countries were ng, those to the colonies, and partly to , were increasing. It was hardly fair t every year to show an increase to ntry in the world; there must be ups and d there might be special circumstances which he export to Australia in one particular year; might be well satisfied with the increase which place in our Australian trade during the last n years. With regard to the main question, he exception to the apparently exaggerated im- attached to foreign trade; and he did not agree atters of home trade what one man gained ssarily be at the expense of another; as a rule, hange which took place was to the mutual both parties. He believed the home trade, he foreign, was really the important matter. ne also seemed to found his anticipations for s on the assumption that trade revived more han it went back, and that when it began s, the highest point was soon reached, gave as an instance the period of the erman war. Now he took exception to that r. The revival of trade there referred to, did ence after the war, but long before, and was ing when the war broke out. He remembered noticing the revival of trade which took place in Lancashire in the autumn of 1869, and 1870 was really a very prosperous year, so much so, that when the war broke out, it caught the Stock Exchange in the full swing of speculation, and the result was a panic, unprecedented in the memory of the present generation. The proper year, therefore, to compare with 1880, was 1870. It was very likely that the present revival had been unusually rapid; but whether it would soon attain its maximum, and give place to a reaction, was a question which he agreed with Mr. Walford it would not be wise to discuss with too much obstinacy on one side or the other. They could never be sure, with all the pains they might take to form an absolutely correct anticipation of what would happen. According to past experience, there was reasonable ground for supposing that business would go on improving, but it would be foolish to attempt to predict with certainty. Some of the political causes for not expecting a very favourable result he thought Mr. Bourne had dwelt too much upon, for instance, the political troubles in India and at the Cape. The amount of money involved, though large, was very small when compared with the magnitude of our commerce. The succession of bad harvests had probably had much more influence. He would conclude by expressing his entire approval of Mr. Bourne's remarks with respect to the state of speculation at the present time, especially in securities. There could be no doubt that the advance, which was the cause of so much satisfaction to many people, was only a change in the nominal expression of wealth, and represented no real increase. People were really no richer than they were before, and one of the dangers of the future was the length to which the speculator might go.

Mr. Bourne, in reply, regretted that the main purport of his paper had not received more consideration. The point for consideration was what lessons for the future could be drawn from the past, so that their operations might be guided accordingly; and he must remind the meeting that, having previously written several papers, which would be found collected in a volume in the Library he had now omitted many points with which he had before dealt. For instance, he had fully considered the question raised by Mr. Hill with regard to the influence of freight on the value of exports and imports; and on the present occasion, his object being to compare one period with another, the figures being on the same basis throughout, their absolute accuracy was not of importance. The purchasing power of money was much too large a question to say anything useful upon at that late hour. His object had not been to give a gloomy view, but to put the facts fairly before the public, and he must congratulate himself that he had been the means of directing attention to the real state of the case, which had not been without some advantage in the influence it had had on the conduct pursued. He looked with a great deal of suspicion on the progress of our trade, and a great deal of the political economy of the present day, but, as for looking with any depression on the condition of England, he did not. He only wished to point out the sources from which she might arrive at a grandeur and wealth far beyond what she had ever achieved. The two great requisites were the study of economy and an attempt to follow the American example by taking in our outlying territories, moving our population east, west, north, and south, and embracing in the sphere of our cultivation those portions of our dominion which would furnish prosperous and comfortable homes to those who were now in poverty and destitution. He had no pretensions to prophecy; he only reasoned on the past, to show why it justified an anticipation of the future, and wherein present circumstances differed from past, so that we might learn how best to meet that which was coming. This was the same as was now done with regard to the weather; we obtained information from America of what was passing there at the moment, and from that

drew conclusions as to the weather we might shortly expect in Europe. If he had dwelt more upon the gloomy side, it was because it was more important to guard against possible evils, than to look out for coming prosperity. He had no belief in cycles or the sun-spot theory; but there was the fact, that alternate periods of the inflation and depression had hitherto occurred pretty regularly, and this led many people to suppose that the same thing must happen again, and so speculate largely on the the first indications of a revival; and it was this he wished to guard against, as it led to artificial inflation and a corresponding depression which need not otherwise occur. When he said that the rise was more rapid than the fall, he alluded to this influence. He was glad the Chairman agreed with him that the speculation at present going on was excessive; he feared it would produce an inflation, for which they would suffer severely afterwards. He could not now discuss the question of free trade, but it must be remembered that the circumstances of England differed so greatly from other countries, that we must needs follow a different policy. Here we had a population which we could not feed from our own stores; while America had a population which could not consume half of what she raised. As to the statement that we wanted an extension of trade, rather than an expansion, that was the argument he had constantly enforced; we wanted to enlarge our sphere of operations. With regard to the periods he had selected, 1872 was the period of highest elevation, and 1879 that of the lowest depression, and, therefore, he thought they were fairly selected. Mr. Liggins regretted that so much of our colonial sugar went to New York, but for his part he thought if we could get good customers in any part of the world it was matter for congratulation. The question of exports and imports he had treated fully elsewhere. He was surprised at the Chairman thinking he had taken too gloomy a view, but as he had already said, his only object had been to guard against possible evils, on the principle that forewarned was forearmed. Still, he could not take the cheerful view which was adopted by many writers at present. All the writings of the day seemed in favour of speculation, and that led to the inflation, which caused a subsequent depression. With regard to the home consumption of iron, he had taken the figures from trade circulars. The assumed make and the annual export did not leave a sufficient balance to account for the enormous home consumption which was generally assumed.

The Chairman said the exports were very large in the early part of the year, and the increased consumption at home was mainly in the last three months.

Mr. Bourne said he had only quoted the absolute figures. At any rate, he thought the exports of iron were likely to fall off. With regard to the troubles in India and the Cape, it was not altogether the amount of expenditure to which he referred, but to the fact that we had been killing our customers rather than encouraging them. The question of the morality of the proceedings was one which he would not attempt to enter upon. He was glad that Mr. Giffen endorsed what he said about speculation, for it was that they had most to fear at present. The belief that the trade must necessarily advance by leaps and bounds, was likely to produce a vast amount of that evil, and the growth of the speculative spirit in the present day had raised up and maintained a large portion of the community, who, instead of being producers, were living on the labour of others; and this was one of the most disastrous things connected with trade which could happen. No language could be too strong to condemn the fact of our having in our midst such a large number of non-producers, who did nothing whatever to add to the wealth of the country, but simply by passing goods from hand to hand, and stimulating purchases to an undue extent, absorbed from t[he] labourers a large proportion of their gains. [...] one of the most fatal elements in the present [...]tion of our trading society, and the one most [...] to guard against.

Votes of thanks to Mr. Bourne and the [...] concluded the proceedings.

CORRESPONDENCE.

SIGNALLING BY MEANS OF SOU[ND]

In reference to Mr. H. P. Babbage's le[tter] appeared in the last number of the *Journal*, I [...] to say that the proposal of the late Mr. Charl[es] [...] received the most careful consideration in 18[...] experience of the Elder Brethren of the Tri[nity] [...] as practical seamen, was quite opposed to its [...] or indeed practicability, for the distinguishin[g] [...] lighthouses.

As regards its application to sound signa[ls] [...] P. Babbage does not appear to have any ade[quate] [con]ception of the requirements of the marin[er] [...] ineffectiveness of such a system for the purp[ose] [...] the difficulties, expense, and risk to naviga[tion] [...] would be involved by its introduction in pl[ace] [...] now in existence.

All practical seamen condemn any system [...] [ne]cessitates exceedingly accurate and strained o[bservation]. When the mariner's mind is full of anxiety, [...] labouring under the influence of a strong wi[nd] [...] sea, he does not then desire to have to count [...] the flashes, the occultations or sound blasts, [...] assure himself of his position. Especially [...] time would the numerical system be liable t[o] [...] any of the signals may be temporarily o[bscured by] steam, by the rolling of the vessel, or by a p[...] Suppose the master reads 323 for 333 and [...] course on the supposition that the light is N[...] would be the consequence of such a mistake[?]

The late Mr. Charles Babbage, as a di[stinguished] mathematician, was naturally very famili[ar with the] language of figures, and, probably, Mr. H. [...] inherits something of his father's proclivity [...] gentlemen, and, indeed, to most landsmen [...] a chart, it would appear that the simplest [...] be to number every lighthouse and every so[und signal] and cause it to indicate that number [...] Nothing could apparently be easier or mo[re ...] But they seem to forget altogether that [...] themselves would not be exhibited to the m[ariner; he] would see only flashes, or occultations, or he[ar ...] which he would have to interpret the n[umbers] [...] times when, as I have before indicated, all [...] would be required for the management [...] itself, and when he would be especially lia[ble to] a mistake.

It is almost time that this controversy cam[e] [...] so often has it been shown that the argum[ents of the] advocates of refined distinctions are fallacio[us] [...] really wanted is extreme simplicity, regard[ed from the] mariner's point of view, not from the point [of view of] the mathematician, electrician, or any othe[r] [...] Each signal must proclaim to the mariner, i[n as short a] time as possible, its own character, so tha[t he may at] once recognise it. That is the object aime[d at by the] lighthouse authorities at the present time, a[nd ...] efficient, and adapted to the requirements of [...] is acknowledged by all practical seamen wh[o] [...] of our coast signals, and is only called in [question by] those whose experience has not made them [acquainted] with the practical necessities of the case.

E. Price

London, 26th January, 1881.

TIONS FOR PREVENTING LONDON SMOKE.

; week's *Journal* (28th January), in Mr. Mon- iper on the above-named subject, he refers to l Arsenal Gas Works as having practically his scheme of "using fuel, from which a cer- portion of gas only has been extracted."

as not present at the meeting, and unaware . Moncrieff intended referring to the works y charge, I beg to be allowed to refute the ts in his paper, in so far as they relate to the rsenal, or any other of the Government gas

ears ago, during an exceptionally busy period, e Government departments were working all as unable to meet the greatly increased de- gas, and was therefore compelled, at that occasionally since, to work a few ovens -hour charges, so as to obtain a larger of gas in the 24 hours than could possibly d by means of the ordinary six-hour it it is quite a mistake to suppose, as might , that I only obtained 3,333 cubic feet per carbonised, or that the short extraction was aply owing to the coke from the short time eing greatly superior to ordinary gas coke," assisting the operation, seeing that in the d with the four-hour charges a volatile cannel d, the coke from which contained very little erties, and consequently was not used as fuel torts; and so far from "superiority of the charges being proved," as stated, the plan o be very expensive and uneconomical, and orted to in order to meet a few exceptional ; and it is not likely to be adopted again, the works have recently been enlarged to nt that I shall be able at all times in future, six-hour charges, and taking all the gas I of the coal, to keep a sufficient stock on hand requirements of the departments, under any hat are ever likely to arise.

erefore, on behalf of all the Government nder my superintendence, disclaim any right given of having adopted Mr. Moncrieff's roducing coke containing a large quantity am sure the War Department would be far d if, instead of producing, as at present, 00 and 10,000 cubic feet of 16-candle gas oal carbonised, I were to give them about this quantity, and to offer a greatly in- d of tar in lieu thereof, with coke from a small proportion of the gas had been ex-

J. A. C. Hay.

al, Woolwich,
anuary, 1881.

. Wallace, who manages the Royal Arsenal under my superintendence, assures me that furnish the statements contained in Mr. paper in regard to these works, and that en made without his knowledge or consent.

J. A. C. H.

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r read last Wednesday, by Mr. W. D. rieff, on "Suggestions for Preventing oke, and making it commercially available," t if the 4,000,000 tons of coal used in heating purposes were all put into the re- gas companies (in addition to the coals now ose companies), and manipulated, as he ondon would be a "smokeless city," and ving of some two millions sterling effected. Moncrieff asserts that if the gas companies ly one-third the quantity of gas they now ton of coal, the coke, or "smokeless fuel," a heating capacity of fully 20 per cent. greater than common coal, and 10 per cent. greater than coke; but we are not favoured with any statistics to prove this, against which I will take the lecturer's own figures—the paper assumes a commercial aspect—how is it then that if coke has a heating capacity of 10 per cent. in excess of coal, its commercial value is 25 per cent. less—coke being valued at 12s. per ton, against 16s.? I venture to think this question should be treated in a practical manner, and taking Mr. Scott-Moncrieff's figures, I submit the following, from a gas maker's point of view:—

Present Nett Cost of Coals for making London Gas.

2,000,000 tons of coal, at 16s.		£1,600,000
Labour thereon, at 2s.		200,000
		£1,800,000
Less tar and ammonia, at 3s. 9d. per ton of coals	£375,000	
1,000,000 tons of coke, at 12s. ..	600,000	
		975,000
Nett cost of coal under present *modus operandi*		£825,000

Mr. Scott-Moncrieff proposes that, instead of using two million tons of coal, the gas companies should use six millions.

6,000,000 tons of coal, at 16s.		£4,800,000
Labour thereon, at 2s, ...		600,000
		£5,400,000
Tar and ammonia is valued at double present sales, or 2s. 6d. per ton of coals	£750,000	
And if no more coke were used for carbonising "in the retorts, on an extraction of less than three hours, instead of six hours, at present prevailing," there would be 3,000,000 tons of fuel for sale, which I cannot value at more than 10s. per ton	£1,500,000	
		2,225,000
Nett cost of coal under proposed new system		£3,175,000

I may add, in passing, that Mr. Scott-Moncrieff calculates 17 cwt. of coke made per ton of coals under the proposed system, against 13 cwt. as at present, with a per-centage used for fuel only, 19½ against 23 at present. I submit that not more than, if so much, as 10 cwt. of coke per ton of coals would be left for sale by the more frequent charging of the retorts.

Mr. Scott-Moncrieff assumes that, by making only one-third of the quantity of gas now made per ton of coal, the illuminating power would be raised from 16 to 24 candles, *i.e.*, 50 per cent., and that the gas would be worth 50 per cent. more money, or 5s. 3d. per 1,000, instead of 3s. 6d., an increase of 1s. 9d. per 1,000, which the consumers would be called on to pay.

I don't think this requires more than a passing notice. A gas consumer, with two burners in his room or shop, can use a third if he chooses to increase his light. Why does he content himself with two? Simply because he does not want to pay for the third or extra light.

We have not been favoured with facts from actual workings, and I think the members of the Society of Arts would like to be informed.

1st. Whether a 16s. coal, producing 10,000 cubic feet of 16-candle gas, will produce at the consumer's burner 3,333 cubic feet of 24-candle gas; 2nd, where and when has the test been made, proving that the coke of 3,333 gas "has a heating capacity of fully 20 per cent. greater" than the coal from which the gas has been extracted.

At the Beckton Gas Works, a year or two ago, there were literally mountains of coke which was unsaleable in London, and had always to be given away in shipment to the Continent. The severity of the last two winters has kept coke stocks pretty clear. Is it to be assumed that the "smokeless fuel" proposed to be made will command a better sale than the ordinary gas coke? I think it may be taken for granted that such fuel exposed for a few days during the recent weather, would have become a heap of rubbish on removal from the gas works.

According to my figures, London, instead of having four million tons of coal and one million tons of coke for fuel, would have to be content with three million tons of "smokeless fuel," and the gas companies saddled with an increase of £2,350,000 in the cost of producing their gas. R. H. Jones.

Sydenham, 31st January, 1881.

KITCHEN BOILER EXPLOSIONS.

Having regard to the number of kitchen boiler explosions occurring at the present time, many of them attended with fatal consequences, it might perhaps be of service if you could find room for the following in your columns. Lavington E. Fletcher.

Instructions for a Placard.

On the recurrence of frost, it might be well to have placards printed in large clear type and posted in prominent positions in the public thoroughfares or other suitable places, explaining to the public the best means of preventing kitchen and circulating boiler explosions.

Text for Placard.

Manchester Steam Users' Association on Kitchen and Circulating Boiler Explosions.

Kitchen boiler explosions are due to an accumulation of pressure in the boiler, in consequence of the outlets being stopped up while the fire is burning. These explosions occur during the frost through the choking up of the pipes with ice. Sometimes stop-taps are placed in the circulating pipes, and should these taps be shut, or should the circulating pipes become choked with sediment, or stopped up from any other cause, the pressure would then be bottled up, and an explosion might result at any time, whether summer or winter.

To prevent this, every boiler should be fitted with a small reliable safety valve, whether the boiler be of copper or cast-iron, and whether it be fitted with a copper cylinder or not. A safety valve of dead weight construction is recommended as the most simple. In the event of the outlets becoming choked, it would relieve any undue pressure and prevent an accumulation, while at the same time it would emit a slight hissing noise, which would tell those in the kitchen that something was wrong.

In the meantime, until a safety valve can be fixed, open the hot-water tap in the bath-room, and any other hot-water taps connected with the boiler. If the water cannot be drawn freely from these taps, do not light the fire, and if the fire be already lighted, put it out at once. If the water flows freely, the fire may then be lighted, but this must be done with caution, and the taps just described frequently opened to see that the flow continues, and that the water gradually heats. If the flow does not continue, or if the water does not heat, the supply of water to the boiler must be running short, or something must be wrong with the circulation, and the fire must be drawn. Also the cold-water cistern as well as the ball-tap should be examined, and the cold-water taps in the bath-room, and elsewhere, opened to see that the water supply is free, otherwise the boiler may run dry. When the fire is once lighted, and the circulation proved to be free, the fire should be kept burning by night as well as by day as long as the frost *lasts, otherwise the frost* may get the mastery during the night, choke the pipes with ice, stop bottle up the pressure, and thus lead to the boiler. But the only true safegua safety valve, and the sooner that is fix the better. Lavington E. F

Chi

9, Mount-street, Albert-square, Manchester, January, 1881.

P.S.—The Manchester Steam Users' nothing whatever to do with the manuf the dead weight safety valve recommend be of convenience to the public to state in accordance with the association's dr obtained for 10s. 6d. at Messrs. Isaac S Cathedral-yard, Manchester.

NOTES ON BOOKS

Report upon certain Museums for Tech and Art; also upon Scientific, Pr Technical Instruction, and System Classes in Great Britain and on th Europe. By Archibald Liversidge. (

In 1878, Professor Liversidge, of the Sydney, was desired by the Colonial Se South Wales, and also by the Chancell versity of Sydney, to collect informatio technological and industrial museum schools, &c., of Europe, for the guidanc of Trustees appointed to found a Techn dustrial Museum at Sydney. The Liversidge's investigations are contai port. The first part contains accounts c in London, Edinburgh, Oxford, and Conservatoire des Arts et Metiers, Pa Italian Industrial Museum, Turin. T is devoted to the various institutions and technical instruction is given. C three are situated in Great Britain and in Austria, four in Belgium, forty-one i teen in Germany, three in Holland, fo in Russia, two in Sweden, one (the Poly Zurich) in Switzerland, and one (the Institute of Technology, Boston) in the The appendix contains a list of public to Technical Education, &c., and a sy Stanley's circular upon Technical and cation to her Majesty's representatives their replies (1868).

Trade, Population, and Food: a series Economic Statistics. By Stephen Bou George Bell and Sons, 1880.)

In this volume the author has arrange papers on cognate subjects, published a in the proceedings of societies, so as to f whole. Under the first head, the prog dealt with, and special attention is draw tion of the growing preponderance o exports. The second division relates to the social aspects of trade depression. specially devoted to the finance of nati in which the practicability of the measure proposed for the prevention of pauperism from a financial point of view. The thir voted to the subject of food supply, in wh Wine," and "Drinking and Depress sidered. The result of Mr. Bourne's co follows:—"The needed explanation the menon manifested in the growing ex imports beyond that of our exports is s with a prosperous state of trade and m

e have to feed, and the food required to feed increased beyond the powers of our own soil for; and that other nations have been grow- elligence, wealth, and manufacturing power, the capacity for supplying their own wants, ncreasing, but rather decreasing, their demands e products of our labour by which our ability e food from them is largely maintained. Our s have been multiplied by continuous seasons ished produce from our own soil, whilst agri- operations have been progressively advancing

r Manual of Modern Geography. By John ton, M.A. (London, John Murray, 1880.)

k is compiled on the same plan as the "School of the same author, and is intended for junior t is not merely an abridgment of the larger contains matters which was considered super- e. The introduction contains some general stronomical or mathematical, physical, and ography.

GENERAL NOTES.

ber.—Information concerning the plant ea Ceara-rubber is contained in the report on by Dr. H. Trimen, of Ceylon. The plant is nd will grow in a dry, rough soil, and a mode- ot atmosphere, while the Para and West India s require a rich alluvial soil, and a constantly osphere. Ceara-rubber plants have been found Ceylon, Calcutta, and Madras, but the climate e is too wet for them. It is suggested that hould be formed on exhausted coffee land. The about thirty feet or more in height, and forms ded crown. It attains a diameter of four or about two years, when it may be tapped.

Sanitation.—Dr. Richardson, F.R.S., will rse of nine lectures on "Domestic Sanitation or ome," before the Ladies' Sanitary Association, of the Society of Arts, on the Saturdays, from th to April 9th. The subjects dealt with in s come under the heads of (1) food and digestion, thy circulation of the blood, and the means of organs of circulation in a healthy state, (3) nd the allied subject of ventilation. A first guineas and a second prize of five guineas, offered hadwick, Esq., C.B., will be awarded to the two who have most distinguished themselves by a of the subjects taught in the lectures. Dr. will also give first and second-class certificates of nd proficiency to students who wish to compete

nical Institute.—The programme for the of the City Technical Science Classes has been fessor Armstrong, Ph.D., F.R.S., and Professor . Inst. C.E., will continue the courses of instruc- istry and physics as applied to the arts and s, at the Cowper-street Schools, Finsbury, in d from the Middle Class School Corporation, erection of the City and Guilds Technical sbury. In the evening Chemistry Classes, Dr. will lecture on "Organic Chemistry, with special its Industrial Applications." The chemistry of products, their uses, and the production of dyeing om them will be very fully considered. The brewing, spirit distilling, and vinegar-making ll form the subject of the lectures after Easter. ng will deliver a course of lectures for junior roductory to the practice and theory of chemistry, s, from 12 to 1 p.m., commencing January 27th. ject of these lectures is to afford such preliminary s necessary for those who may desire later on to ular branches of applied chemistry, but the ention will be specially directed to the technical the subject. He will also give a course of lectures on "Coal Gas, and its uses as an Illuminating and Heating Agent." A junior introductory course will also be given; and there will also be laboratory classes and a Photographic Chemistry Class. In the Physical Class, Professor Ayrton will give courses of lectures on "Electrical Instrument Making," "Electric Light," "Motor Machinery, with especial reference to Electric Lighting," and the "Electric Transmission of Power." In this department also there will be laboratory and junior classes.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at eight o'clock:—

February 9.—"The Present Condition of the Art of Wood-carving in England." By J. Hungerford Pollen. Sir Philip Cunliffe-Owen, C.B., K.C.M.G. C.I.E., will preside.

February 16.—"The Participation of Labour in the Profits of Enterprise." By Sedley Taylor, M.A., late Fellow of Trinity College, Cambridge.

February 23.—"The Manufacture of Aërated Waters." By T. P. Bruce Warren.

March 2.—"On Lighthouses Characteristics." By Sir William Thomson, LL.D., F.R.S.

March 9.—"Improvements in the Treatment of Esparto for the Manufacture of Paper." By William Arnot, F.C.S.

March 16.—"Buying and Selling; its Nature and its Tools." By Prof. Bonamy Price, M.A. Lord Alfred S. Churchill will preside.

March 23.—"The Increasing Number of Deaths from Explosions, with an Examination of the Causes." By Cornelius Walford.

March 30.—"Recent Advances in Electric Lighting." By W. H. Preece, Pres. Soc. Tel. Eng.

April 6.—"The Manufacture of Glass for Decorative Purposes." By H. J. Powell (Whitefriars Glass Works).

Foreign and Colonial Section.

Tuesday evenings, at eight o'clock:—

February 22.—"The Languages of South Africa." By Robert N. Cust.

March 15.—"The Loo Choo Islands." By Consul John A. Gubbins.

April 5.—"Trade Relations between Great Britain and her Dependencies." By William Westgarth.

Applied Chemistry and Physics Section.

Thursday evenings, at eight o'clock:—

February 24.—"Deep Sea Investigation, and the Apparatus used in it." By J. G. Buchanan, F.R.S.E., F.C.S. Captain Sir George S. Nares, R.N., K.C.B., F.R.S., will preside.

March 24.—"The Future Development of Electrical Appliances." By Prof. John Perry.

The meeting previously announced for April 7 will be held on May 12.

Indian Section.

Friday evenings, at eight o'clock:—

February 11.—"Gold in India." By Hyde Clarke. Sir William Robinson, K.C.S.I., will preside.

March 4.—"The Results of British Rule in India." By J. M. Maclean.

March 25.—"The Tenure and Cultivation of Land in India." By Sir George Campbell, K.C.S.I., M.P.

May 13.—"Burmah." By General Sir Arthur Phayre, G.C.M.G., K.C.S.I., C.B.

Members are requested to notice that it may be necessary to make alterations in the dates of the above papers.

CANTOR LECTURES.

Monday evenings, at eight o'clock:—

The Second Course will be on "Watchmaking," by EDWARD RIGG, M.A. Three Lectures.

Syllabus of the Course.

LECTURE I.—FEBRUARY 7.

Introduction—Units of Time—Historical Sketch—Description of usual forms of watch—Escapements—Conditions of accurate timekeeping, and arrangements necessary for their maintenance in the higher class of watch.

LECTURE II.—FEBRUARY 14.

The ordinary watch—Degree of accuracy required in it—Systems of manufacture in this country and abroad—Description of specimens illustrative of the various stages of construction—Comparison of the several systems.

LECTURE III.—FEBRUARY 21.

Necessity of efforts to promote the art in this country—Need of education, theoretical and practical, in horology—Literature—Great want of uniformity in gauges, screws, &c.—Exhibition of ordinary and complicated watches, and of watchmakers' tools—Conclusion.

The Lectures will be illustrated by Specimens, Models, and Diagrams. The different movements, &c., will be shown enlarged on the screen by means of the Aphengiscope and the Electric Light.

The Third Course will be on "The Scientific Principles involved in Electric Lighting," by Prof. W. G. ADAMS, F.R.S. Four Lectures.

March 7, 14, 21, 28.

The Fourth Course will be on "The Art of Lace-making," by ALAN S. COLE. Three Lectures.

April 25; May 2, 9.

The Fifth Course will be on "Colour Blindness and its Influence upon Various Industries," by R. BRUDENELL CARTER, F.R.C.S. Three Lectures.

May 16, 23, 30.

ADMISSION TO MEETINGS.

Members have the right of attending all the Society's meetings and lectures. Every Member can admit *two* friends to the Ordinary and Sectional Meetings, and *one* friend to the Cantor Lectures. Books of tickets for the purpose have been issued to the Members, but admission can also be obtained on the personal introduction of a Member.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 7TH ... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Edward Rigg, "Watchmaking." (Lecture I.)
Farmers' Club, Inns of Court Hotel, Holborn, W.C., 4 p.m. Mr. J. Bailey Denton, "The Management of Rivers."
Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.
Society of Engineers, 6, Westminster-chambers, 7½ p.m. Presentation of the premiums awarded during the past Session, by the late President, Mr. Joseph Bernays. Inaugural Address by Mr. Charles Horsley, President.
Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Discussion on Mr. Joseph Lucas's paper, "Rural Water Supply, with Special Reference to the Objects of the Public Health (Water) Act, 1878."
Medical, 11, Chandos-street, W., 8½ p.m.
Victoria Institute, 7, Adelphi-terrace, W.C., 8 p.m. Dr. S. Kinns, "The Truths of Revelation Confirmed by the Advance of Science."
London Institution, Finsbury-circus, E.C., H. S. Maine, "Succession to Thrones."

TUESDAY, FEB. 8TH...Royal Institution, Albemarle-s p.m. Prof. E. A. Schäfer, "The Blood." (
Central Chamber of Agriculture (at the H SOCIETY OF ARTS), 11 a.m.
Medical and Chirurgical, 53, Berners-str street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. C. Colson. "The Dockyard Extension Works (2nd Part)." Meyer, "The Plant and Temporary Works Portsmouth Dockyard Extension."
Photographic, 5A, Pall-mall East, S.W., 8 p General Meeting.
Anthropological Institute, 4, St. Martin's- 8 p.m.
Royal Horticultural, South Kensington, S.W

WEDNESDAY, FEB. 9TH...**SOCIETY OF ARTS**, Adelphi, W.C., 8 p.m. Mr. J. Hunger "The Present Condition of the Art of W in England."
Graphic, University College, W.C., 8 p.m.
Microscopical, King's College, W.C., 8 p. Meeting for Election of Council and Office
Royal Literary Fund, 10, John-street, Ad 3 p.m.
Royal Institution, Albemarle-street, W., 3 Sidney Colvin. "The Amazons." (Lecture
Sanitary Institute of Great Britain, 9, Condui 8 p.m. Mr. W. H. Michael, "The Law in Sanitary Progress."

THURSDAY, FEB. 10TH...Telegraph Engineers and 25, Great George-street, S.W., 8 p.m. Mr Adams, "Earth Currents—Electric Tides."
Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
London Institution, Finsbury-circus, E Prof. Monier Williams, "The Castes an India."
Royal Institution, Albemarle-street, W., Francis Hueffer, "The Troubadours." (L
Inventors' Institute, 4, St. Martin's-place, W
Royal Society Club, Willis's-rooms, St. Ja 6 p.m.
Mathematical, 22, Albemarle-street, W., 8 E. B. Elliott, "Some Theorems of Kin Sphere." 2. Mr. J. W. L. Glaisher, "So expressible in the terms of the first comp and of Gamma Functions." 3. Herr Schl burg), "Mr. McColl's Calculus of Equiv ments."

FRIDAY, FEB. 11TH...**SOCIETY OF ARTS**, John-str W.C., 8½ p.m. (Indian Section.) Mr. I "Gold in India."
Royal United Service Institution, Whitehall- Lieut.-Col. C. R. Sherrington, "Army Tran
Royal Institution, Albemarle-street, 9 p.m. Ball, "The Distance of the Stars."
Astronomical, Burlington-house, W., 8 p. General Meeting.
Quekett Microscopical Club, University Co 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m. Ann
Folk Lore Society, 22, Albemarle-street, W., W. S. Lach-Szyrma, "Folk Lore Traditions Events."

SATURDAY, FEB. 12TH...Ladies' Sanitary Association (OF THE SOCIETY OF ARTS), 5.30 p.m. Dr. B. son, "Domestic Sanitation or Health at H ture I.)
Physical, Science Schools, South Kensington, 1. Annual General Meeting. 2. Special Ge 3. Dr. O. J. Lodge, "A Hydrostatic Ill Electrical Phenomena, and other Lect ments."
Royal Botanic, Inner-circle, Regent's-park, N
Royal Institution, Albemarle-street, W., 3 Sidney Colvin, "The Amazons." (Lecture

ERRATA.—Page 161, col. 1, l. 51, *for* *read* sulphides; p. 161, col. 1, last line, *for* tons, r p. 161, col. 2, l. 9, *for* Anderson, Longmead, A Rhodin, *read* Henderson, Longmaid, Augustin, or Rhodia; p. 161, col. 2, l. 10 from bottom, *for* metals; p. 162, col. 1, l. 36, *for* or about 46 to 6 *read* only about 46 to 48 per cent.; p. 162, col. 1 26 per cent., *read* 96 per cent.; p. 162, col. 1, bottom, *for* miner, *read* mine; p. 162, col. 2, l. 18 body engaged, *read* everybody could not engage.

IAL OF THE SOCIETY OF ARTS.

No. 1,473. VOL. XXIX.

RIDAY, FEBRUARY 11, 1881.

ications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

E TO INSTITUTIONS.—EXAMINATIONS.

ttention of Secretaries of Institutions in rith the Society, is directed to the Pro- of Examination sent to each Institution s week's *Journal*, especially to paragraphs

Institutions desirous of using the ele- papers issued by the Society, are reminded lication for them should be made at once. e 7 of the Programme.

CANTOR LECTURES.

irst lecture of the second course was d on Monday, 7th inst., by Edward Rigg, n "Watchmaking." The lecturer gave a l sketch of the subject, and described the rms of watch escapements, conditions of timekeeping, and arrangements necessary maintenance in the higher class of watch. ectures will be published in the *Journal* he summer vacation.

TELEPHONE EXCHANGE.

ffices of the Society of Arts have lately been d with the Telephone Exchange, the head f which are situated in Coleman-street. ny member of the Society, whose place of is also connected with the Exchange, s communicate with the Society. The s offices are connected, in the first instance, company's Exchange in Chancery-lane, can be put into communication with any tation from which wires radiate to the places using the Exchange system. The re also connected by a private wire to the s printers in Fleet-street, the company's e being now used instead of the Wheatstone A. B. C. instrument, which had previously been employed on a Post-office wire for the same purpose.

HOUSE SANITATION.

The Council offer the following Medals for the best Sanitary Arrangements in Houses built in the Metropolis, the plans of such arrangements to be exhibited in the Society's Rooms, Adelphi, in June, 1881, and to be sent in on or before 12th May, 1881:—

1. One Silver Medal for the best sanitary arrangements, carried out and in satisfactory working, in a house let out in tenements to artisans, for which a weekly rental is paid.

2. One Silver Medal for the best sanitary arrangements, in actual working, in a house of the yearly rental of £40, or less, to about £200 in value.

3. One Silver Medal for the best sanitary arrangements, in actual satisfactory working, in a house of the yearly rental value of £200 and upwards, to any amount.

4. The houses must be open to the inspection of the Judges, who, in considering their award, will be guided by the suggestions of plans for main sewerage, drainage, and water supply, made under the Public Health Act, 1875.* The houses must have been in actual occupation within the last three months, and a Certificate must be given by the occupiers, on a printed form, stating the satisfactory working of all the sanitary arrangements, such form to be obtained at the Society of Arts.

5. The houses may be old, fitted with modern sanitary arrangements, or may be new. They must be within the metropolitan area of the Board of Works.

6. The sanitary arrangements must include the conditions for good water supply, drainage, warming, and ventilation of the house, and precautions taken against frost.

7. The medals may be awarded to the occupiers of the houses, or the lessees, or the owners.

8. The plans must consist of a ground plan and sections, to the scale of not less than one inch to five feet; details of not less than one inch to the foot. The plans may be accompanied by specifications.

9. The names of the architects, surveyors, or sanitary engineers who directed the sanitary arrangements should be given, and Certificates will be awarded to those whose plans obtain the Medals. (By Order)

H. TRUEMAN WOOD, Secretary.

* The Public Health Act has been revised to 1878, and published by Her Majesty's Stationery Office. Price, with plans, three shillings.

DOMESTIC ECONOMY.

1. The Council will hold a Third Congress on Domestic Economy, at the Society's Rooms in the Adelphi, London, during the present year.

2. The Council offer Seven Bronze Medals, and Certificates of Merit for Papers (not exceeding 1,000 words), written by Teachers of Public Elementary Schools and Training Colleges, which shall give an account of the best method practised by the teacher, of the teacher's experience, and the result of the teaching, in any one or more of the seven classes of subjects named below.

3. The Education Department, in the Code of 1880 (p. 31), classes the following subjects under Domestic Economy for Girls:—

The First Branch includes—

(a) Clothing and Washing.
(b) The Dwelling—Warming, Cleaning, and Ventilation.
(c) Rules for Health—The Management of the Sick Room, Cottage Income, Expenditure, and Savings.

The Second Branch includes—

(a) Food—Its Composition and its Nutritive Value
(b) Food—Its Functions.
(c) Food—Its Preparation and Culinary Treatment (*i.e.*, Practical Cookery) (§ 24).

The Council have resolved to add the subject of Needlework, which will be exhibited and discussed in the Congress, although it is not classed in the Code as a branch of Domestic Economy.

4. Only one medal will be given to a teacher but the subjects taught successfully will be inscribed on the one medal and a certificate given.

5. The papers must be sent to the Secretary of the Society of Arts by the 1st May next. Each paper must be enclosed in a sealed envelope, bearing a motto, and must be accompanied by an envelope bearing the same motto, and having within it the writer's name and address.

6. No medals or certificates will be awarded if the papers are not of sufficient merit to deserve them. (By order)

H. Trueman Wood, Secretary.

LABEL FOR PLANTS.

The Council are prepared to award a Society's Silver Medal, together with a prize of £5, which has been placed at their disposal for the purpose by Mr. G. F. Wilson, F.R.S., for the best label for plants.

The object of the offer is to obtain a label which may be cheap and durable, and may show legibly whatever is written or printed thereon; the label must be suitable for plants in open border. These considerations will principally govern the award.

Specimen labels, bearing a number or motto, and accompanied by a sealed envelope containing the name of the sender, must be sent in to the Secretary not later than the 1st May, 1881.

The Council reserve to themselves the right of withholding the Medal and Prize offered, if, in the opinion of the judges, none of the specimens sent in are deserving.

PROCEEDINGS OF THE SOCIETY.

FOREIGN AND COLONIAL SECTION.

Tuesday, February 1st, 1881; Sir Richard Temple, Bart., G.C.S.I., C.I.E., D.C.L., in the chair.

The paper read was on—

THE INDUSTRIAL RESOURCES OF SOUTH AFRICA.

By the Right Hon. Sir Bartle Frere, Bart., G.C.B., G.C.S.I., F.R.S., D.C.L., LL.D.

When first proceeding to South Africa, I found the greatest difficulty in obtaining any reliable detailed and recent information regarding its industrial resources, and the same difficulty has struck me since my return to England, when I have been often questioned on the subject by those whose attention had been directed to the English possessions in that quarter.

Much that is valuable is to be found well selected and well arranged in Mr. Silver's excellent hand-book,* but there is much which could hardly be compressed into any single hand-book, and though I cannot pretend to supply the want, something may be done towards assisting others to do so, if I briefly state, in the course of the present lecture, a few of such facts connected with the industrial resources of the country, which strike a traveller in South Africa, and if I refer to sources whence more detailed information may be obtained by those who desire it.

I have no striking new facts to communicate. I can give you little more than a traveller's impressions, pointing out where my own information has been derived, and offering to answer any questions on the subject which my hearers may wish to address to me after the lecture has concluded.

I must presuppose a general knowledge of the physical configuration and extent of temperate South Africa, and the relative position and general area of the component States, and I must ask you to remember that temperate South Africa is a very large territory comprising:—

1st. The Old Cape Colony, in which may be now included Kaffraria, Basutoland, and Griqualand West.

2nd. The Colony of Natal.

3rd. The Orange Free State.

4th. The Transvaal.

* Silver's "South Africa." Third edition. Silver and Co., Sun-court, 67, Cornhill. Price 5s.

The Transgariep and Damaraland. Re- the area and population of these provinces, beg to refer to the paper I lately read be Royal Geographical Society, which will id printed, with a useful map, in the number of the Proceedings of that

will bear in mind the various character of ulation. Of Europeans we have large , of diverse origin. English, Dutch, with sprinkling of French Huguenots, an in- number of Germans, and scattered repre- es of most other European races. Of men in race we have those distinguished as the or "yellow skinned races," who claim to be igines of the country, including Bushmen, as, and Hottentots, and men of "black," r dark brown complexions, chiefly of the Bantu family, including Kaffirs, Zulus, ias, and Damaras. Of mixed races we iquas and others, besides important classes ic origin represented by those known as s," men of Javanese race at the Cape, and s" of Tamul and other Indian races in Natal. ding the seasons and meteorology of the I can only briefly here notice that for the rt South Africa lies, as they would say in etween two monsoons, or trade winds, of them throughout the greater part of the very regular, but influencing the general and themselves much modified by the the mountain ranges, which run parallel e coast, and rise by successive terraces to land in the interior. To the west there rally dry summer and a wet winter, to the l we have wet and thundery summers winters. In all cases, we must remember seasons of summer and winter are the to those belonging to our own northern ere.*

the history of this country, I will only now u to the standard works of Mr. John Mr. Theal, and the excellent school abstract Wilmot.†

political constitution of a country is of most important factor in all industrial s, but I can dwell no more on this point remind you that the Cape Colony has re- tive institutions, with a Ministry re- to the Legislature; that Natal has tative institutions, but no responsible ; and that the Transvaal is a Crown colony ominee Legislature, all three being under sh Crown. The Orange Free State has an ent republican Government, with a presi- l volksraad, in alliance with, but quite ent of, the surrounding British colonies. who would desire to know more on the f the various constitutions, may consult Mr. Silver's hand-book, the almanacks and s of the Cape Colony, Natal, and the l, all excellent in their way.‡

The public income and expenditure would naturally require notice, but, at present, I must content myself with referring you to the works I have just mentioned, and to the enclosed papers, which will be printed as an Appendix (B) to this lecture, merely noticing a few salient points in passing.

So with regard to trade and commerce, you will find excellent general abstracts of parliamentary papers in the works I have already mentioned, to which the papers forming Appendix C, will furnish a few additions.

I will now consider, in brief detail, under several heads, the chief industrial resources of the country.

Mineral Resources.

As regards mineral resources, the first place is claimed by coal. It has long been known that considerable coal fields existed in the South African colonies, but, so far as I can learn, there is, in this country, a very inadequate conception of the extent and value of the fields already known; and the researches which have hitherto been made have shown that the known coal fields form but a very inconsiderable portion of those which exist between the sea and the tropic. There appears no reason to doubt that from the neighbourhood of Beaufort West, in the Cape Colony, where the railway from Cape Town at present terminates, coal is to be found in the neighbourhood of both sides of the great line of mountains which follow the direction of the coast from the Nieuwvelt Mountains, in lat. 32° S., at least as far as the Oliphants River, in lat. 24° S., and extensive beds are known to exist north-north-eastward from the Transvaal, being on the surface at more than one part of the Zambesi Valley and appearing also on the surface on the Ravooma River.

But let us now consider more in detail the coal in the Cape Colony. Promising indications of coal have been found in the Nieuwvelt and Camdeboo Mountains, where boring operations are now going on under the Cape Government, and coal is now extracted to a considerable amount at more than one spot between the line of railway from Port Elizabeth to Graaf Reinet and Basutoland. In the Stormberg Mountains, and about Molteno and Dordrecht, in the Indewe Valley, the seams are said to be easily accessible and productive, and appear to be of great extent, but the commercial value of these fields can hardly be ascertained until rail- ways, which have now been constructed up to Beaufort West, Graaf Reinet, Craddock, and Queenstown, shall be further extended.

In the Orange Free State, there appear to be vast deposits of coal between Bloemfontein and the Upper Vaal River, in the neighbourhood of Cronstadt and Winburg; and the reports of Mr. Stowe, a trained geologist, have justified expectations of finding most valuable and extensive fields in the north-eastern portion of the Free State. In a letter dated 6th September last, Mr. Stowe

* ppendix A.

† by Clowes and Son, London, for Juta, Capetown. of Good Hope General Directory," Saul Solomon and own, sold by White, 17, Bloomfield-street, London. anac, Directory, and Register," sold by Algar, 11, ne, Lombard-street, and by G. Street, Cornhill. ... al Almanac," which is full of useful informa- excellent map. "Emigrants' Guide to South Africa," on, 1880, price 1s., White and Co., 17, Bloomfield- lon. There is an "Emigrant's Guide to Natal," published by Lockwood and Co., Stationers'-hall-court, Ludgate-hill, full of useful and accurate matter, as might be expected from the author, Dr. R. J. Mann, F.R.A.S., F.R.G.S., formerly Superintendent-General of Education in Natal. It was, however, published as far back as 1867. It is much to be wished that Dr. Mann would revise it, and bring it up to date. Much later information regarding the colony is to be found in the larger work, "Brook's Natal," edited by Dr. Mann, and published by Reeve and Co., 5, Henrietta-street, Covent-garden, in 1876.—B.F.

states that he has obtained the refusal of mining rights in 24 square miles of country in the heart of the thickest deposits. Magnetic iron is within 15 miles of coal beds, sometimes upwards of 12 ft. thick.

In Natal, coal has been for some time worked to a considerable extent at Newcastle and Dundee, and indications have been found in other parts, as at Estcourt; but these deposits are not likely to be developed till means of carriage are improved. I have been informed by Dr. Mann, that he found, when he was at Pietermaritzburg, that he could get coal cheaper from England *via* Durban than he could from the field that had then been recently discovered in the neighbourhood of Newcastle. The Newcastle beds, which I visited, appear to extend to a great distance, and to improve in quality in an easterly direction towards Zululand. Before he advanced from Kambula, Sir Evelyn Wood furnished fuel to a great part of his column for a considerable time, from surface beds which he discovered near the then Zulu boundary, and it is clear that these Natal and Zulu beds are of very considerable extent.

On the north-western side of the Drakensberg, beds re-appear, apparently continuations of those above described in the Orange Free State. At Standerton, I found the people habitally using, as their fuel, coal which they carted from an open surface pit a few miles distant; and indications of coal are met with both to the north towards Lydenberg, and westward down the valley of the Vaal River.

At present, all these fields are but little worked, owing to want of means of cheap carriage, but at some places, as at Kimberley, the price of fuel is so enormous as to render it possible to bring this coal in wagons from a distance of several hundred miles. Between Potchefstroom and Kimberley, I overtook several wagons of coal, containing four tons each. It was being brought as a speculation from surface mines between Potchefstroom and Heidelberg, and could, I was told, be sold at a profit after this long cartage at Kimberley; but then it must be remembered that £17 was no unusual price for a wagon load of firewood at Kimberley, so that any substitute could bear long carriage. We may hope that Kimberley will before long be better supplied with means of transport, by which coal can be brought both from the seaboard and the interior. In that case, some cheaper and more powerful means of transport than a bullock wagon must be found, if the Transvaal coal is to be profitably worked. The country is open and well adapted, not only to railroads, but for navigable canals, which could be most easily and cheaply constructed from any part of the Upper Vaal River to Kimberley.

At present, South Africa is entirely dependent for its supply of iron on imports from other countries, but there is abundance of iron ore in the vicinity of coal-beds, easily procurable and easily worked, and only waiting a supply of cheap transport and abundant fuel to enable it to be worked to advantage.

Manganese has been found in several localities. There are mines which have been for some years profitably worked near Wellington, in the western Cape Colony.

Cobalt has been found in rich and easily-worked *mines north* of Middelburg, in the Transvaal, and indications have been discovered to the south of the Drakensburg, in Natal.

Lead mines of great richness have been worked at Marico. I met four wagons laden with pigs of Marico lead near Pretoria. The mines have been worked and the lead extracted by Mr. Bray, an enterprising Englishman; and here again better means of carriage were all that was needed to render the mines of great value.

Valuable copper mines have been worked for some time in Little Namaqualand, and the exports of copper ore from Port Nolloth to Swansea are of great annual value. When the mines were first worked in 1854, a copper mining mania prevailed in the Cape Colony. Thirty companies, to dig for copper, were formed, with nominal capital amounting to £1,393,000. Many were ruined by the subsequent crash, and only one copper mining company survived. The average yield from 1858 to 1867 was 4,000 tons of ore.

The railway from Port Nolloth to Ookiep (93 miles in length), has since been constructed by the Copper Mining Company, and the average yield is valued at about a quarter of a million sterling per annum. Still, richer mines are said to exist beyond the British boundary in Damaraland, where a considerable amount of almost pure native copper is found and worked by the Bushmen and wild tribes north of the Damaras.

Great expectations were, at one time, formed of the richness of the Transvaal gold fields, and a considerable amount of gold is even now extracted from the gold fields in and beyond the Lydenberg district about Pilgrim's Rest and Macmac. Much more would probably be worked if the country were settled, but here and in other parts where gold has been worked, as, for instance, in the mountains between Pretoria and Potchefstroom, the gold hitherto found has been, for the most part, in quartz, and cannot be extracted without more machinery and cheaper fuel than the miners have as yet been able to command. To the north and north-east of the Transvaal there are said to be very productive gold fields, from the best portions of which miners have hitherto been excluded by the jealousy of native chiefs. But if I may trust the opinions which have been given me by gold miners of considerable experience in California and Australia, there is some danger that the accidental discovery of a really good field might at any time induce an influx of gold diggers, who would not be content till they had removed all difficulties, political as well as physical, which at present limit this branch of industry.

The great and increasing diamond mines in Griqualand West and the Orange Free State would require more than one lecture to do justice to a subject of such importance. I can only, therefore, here remind you of a few salient facts. It is only fourteen years since the first diamond was discovered in South Africa, and the exports since then have so enormously increased, that in one year more than three and a half millions pounds worth of diamonds have passed through the Cape post-office, besides diamonds of a very large value which were exported in other ways. The principal mines, I need hardly tell you, are at Kimberley. They are found in what appear to be the remains of extinct subaqueous craters, formed by the

of fluid mud and gases which have forced through the sandstone and other strata, .t is now the surface, but which seem, when .ters were formed, to have been under a lepth of water. The subterranean forces rmed vast craters, more or less regular in and which, till the diamond digging com- , were filled up with fragments of rock · less altered by subterranean heat, and with rolcanic indurated clay or tufaceous mud, s is still ejected from the active mud es on the Mecran Coast, between Persia lia. In such indurated clay, the diamonds nd embedded. The clay is of stony hard- hen first dug out, but rapidly decomposes the influence of the atmosphere, acting on lphate of iron with which it is largely d, and the precious stones are then easily l out.

les diamonds of every variety of colours ter, garnets and similar stones are found, are hardly noticed at all by those who are ing the diamonds, but the collection of may ultimately form a branch of industry. d Kimberley Mine, which has now reached pth of 300 feet without any indication of the supply or the quality of diamonds , is a very regular shaped crater. The ing mines of Du Toit's Pan, Old de Beers, iltfontein, are more irregular in shape, and een less deeply excavated; but it appears, he discovery of diamonds in other "pans," y are called (*i.e.*, depressions indicating of subterranean forces), which are found in s parts of the adjoining country, that the rley mines are by no means singular in the which they contain. The Jager Fontein gs, near Fauresmith, in the Orange Free are already largely worked, and we hear of mines being opened in the neighbourhood. esides the "pans," or "dry diggings," as re sometimes called, where the diamonds e supposed to be found *in situ* in the ted clay which embeds them, diamonds, of them of the finest water and of great have been found in alluvial or "river dig- " near the banks of the Vaal and other They appear to have been washed out of original matrix, and deposited with gravel alluvial soil near the present course of the The working of these alluvial mines is laborious, owing to the great size of the rs which have to be removed, and the for the industry expended on them is less , as the diamonds are found very irregularly uted—sometimes many together and some- none at all—but, when found, they are lly valuable stones, as imperfect stones, and liable to split on exposure, are less com- met with than in what are called the dry gs, in the old craters.

e does not admit of even brief notice of ning communities, which have settled at the nd fields. A very graphic account of the will be found in Mr. Anthony Trollope's tern South Africa." His description, though valuable matter, is not always drawn with a ng pencil. I have extracted from the *South* s, and added as an Appendix* to this paper, a very useful and succinct description of the Diamond Fields, by Mr. R. W. Murray, who has been long resident there, and who knows the fields and their inhabitants as well as any living authority.

* Vide Appendix D.

I may here mention that about a century and a half ago, London was the chief seat of the art of cutting diamonds; but the industry was subsequently removed to Amsterdam, which, till lately, had a monopoly of the business. It has since been restored to England by Mr. W. Ford, of Clerken- well-green.* An account of the mode of splitting a diamond, with an illustration of the tools used, is given in the late Rev. Arthur Rigg's Cantor Lectures on "Tools" (*Journal*, vol. xxiii., p. 820).

We are indebted to Professor Tennant for a beautiful collection of South African diamonds and other gems, which he has allowed to be ex- hibited here this evening.

Fine specimens of asbestos have been brought from the Asbestos Mountains in Griqualand; and agates, cornelians, garnets, &c., though they do not form objects of industry, have been collected of considerable value, and probably would well repay more careful research. They are found in the river gravel in all parts of the lower course of the Orange River, nearly down to its mouth.

Good slate is found in various parts of all the colonies, but English slates are cheap and good. The local slate quarries cannot be worked without an abundant supply of labour and capital, and the slates used are consequently for the most part im- ported. It is the same with regard to marble, which has been found of good quality near Worcester, and in some of the southern portions of Natal. Of good building stone and brick earth there is no want, and with the exception of timber, building materials are almost everywhere cheap and abundant. Porcelain clay, of very good quality, has been found in the neighbourhood of Cape Town, and a factory has been set up for pottery.

Salt is largely produced in the Transgariep territories, and the salt-pans west of the Vaal and Hart Rivers are of considerable value even now.

Before quitting the subject of the mineral re- sources of South Africa, I may be allowed to bear my testimony to the general accuracy of the in- dications of mineral resources given on the face of Jeppe's map of the Transvaal. I confess that, before I went to the Transvaal, I was sceptical on the subject, but wherever I had opportunities of testing the information so given, I found that the minerals mentioned by Jeppe were always to be met with, though of course, not always in quantities to pay the expense of mining.

Guano, though of animal origin, may be mentioned here as an object of colonial industry. It is produced on the rocky islets on the West Coast, where there is little rain. Most of the old deposits, on Ichaboe and other islands, have been long since cleared away, but there is a consider- able amount of fresh deposit yearly, from the myriads of seabirds which frequent the coast in the breeding season, after which, the guano is swept together and collected. The groups of rocks and islets, twenty in number, are leased for various periods of from 5 to 26 years, at a total

* Vide Appendix D.

annual rent of £2,410, besides the dues levied on the guano collected. The quantities collected during eight years, averaged more than 2,000 tons of guano per annum, valued at £6 per ton, besides sea fowls, eggs, feathers, and fish oil, to an average further value of £2,255 per annum. (Cape Parliamentary Return, 1880.)

Agricultural Resources.

Let us now turn to the agricultural resources of South Africa. Let me, in the first instance, state that from Durban, round by the route which Sir George Colley is now following to Pretoria, and thence, *via* Potchefstrom, to Kimberley and Beaufort West, and so by railway to Cape Town, a course of not less than twelve hundred miles, besides other visits to the Kaffir frontier and many districts between Port Elizabeth and the Baashi River, I have seen enough of South Africa to gain a very good general idea of the character of its soil and other requisites for agriculture. Throughout the whole distance I have travelled I find it difficult to recall more than a mile or two at a time of barren and unfertile country. Mountains there are, and stony wastes, where there is barely food for more than a very small number of sheep to the square mile; but, of hopelessly unprofitable land, except on the mountain ranges, it is difficult to find more than a few patches here and there. On the other hand, the country abounds in long stretches of extremely fertile land, such as would be valued in any country in Europe, and with every variety of climate similar to what would be met with in the northern hemisphere, from the extreme north of the temperate zone to the semi-tropical regions of Northern Africa. In parts, especially in the Transvaal and on the coast, the pasture for large cattle is extremely rich and abundant, and further away from the coast the country is admirably adapted for sheep farming. It is a peculiarity of South African pasturage that it is as often found upon shrubs and bushes as among the grasses of the field. Some of the districts where the Merino sheep flourishes best, possess hardly a blade of grass, but there is abundance of food to be found in the shoots of various plants, chiefly aromatic in scent, and adapted by habit to resist long droughts. On these the sheep thrive, and can produce as good wool and mutton as upon any downs in England or Spain.

Water is abundant in most parts of South Africa, to the extent required by the farmer. It is not always on the surface, indeed, in many vast regions, it is very rarely to be seen on the surface, and such districts have hitherto, in many cases, been accounted barren and uninhabitable, except for a few months after rain; but the farmers are now becoming alive to the fact that, below the surface, even in portions of country which have hitherto been supposed to be quite arid and unprofitable, water is generally to be found by digging at moderate depths; and I can testify, from my own observation, that, in many districts where want of water is now much complained of, it could be found if the people would only expend on well-digging the ordinary amount of labour which is required for agricultural existence in most parts of Central India, Rajpotana, and the Deccan. But there is a still greater field for increasing the present water supply by means of canals, which might, to an enormous extent, be drawn from the rivers in almost every part of the country. Much has been already done on a small scale by farmers; and on some of the large farms in the Karroo, I have seen thousands of pounds expended by farmers in what are locally called dams, or reservoirs formed by embankments across valleys, and by what are called "leading furrows" from running streams.

For wells, and for such small works of irrigation from streams, the country may, I think, safely trust to the enterprise and capital of individual farmers; but I hope the time is not far distant when the Government in South Africa will turn its serious attention to large schemes of irrigation from the great rivers with which the country abounds. It is not necessary to go to Africa for the purpose of satisfying one's self of the immense returns which would follow such a system of large irrigation works from some of the more considerable streams, on the scale of which every province in India affords so many examples. If we look, for instance, at either the Orange River or the Vaal on any large map, we see the course of large perennial rivers, which carry an abundant supply of water even in the driest months of the year, and after the most prolonged droughts. They are fed, in fact, from springs in the great ranges parallel to the coast, which never fail to have a supply of annual rain, however much the low country may suffer from the want of it. These streams run in the earlier part of their course frequently over rocky beds, affording every facility for dams such as are required to turn the course of the stream into channels excavated at the side. A very short distance of such excavation would suffice in almost every case to lead the water clear of the deep river bed on to the level of the country around, which has a gradual slope, generally westward and northward, enabling a canal to be carried for hundreds of miles over undulating country, which appears as if made for artificial irrigation, continuing down the course of those great rivers to within about 100 miles of the great Atlantic Ocean.

On a smaller scale, the facilities of most other rivers which have a course northward or westward from the great mountain backbone of the continent are quite equal to those of the Orange River and the Vaal. Even the sandy river beds which traverse so much of the Karroo might be turned to valuable account by works of the kind I have indicated. All these river beds are the channels of a flooded stream once or oftener during the course of most years, and carry, during such temporary floodings, a vast quantity of water which now runs to waste into the ocean. In any part of India such streams would be utilised by making them give a thorough soaking to a dry plain at some distance down the valley, or they might be made to fill artificial reservoirs which are formed by damming up the lower extremities of hollow valleys, and they would thus furnish, if not water for cultivation, certainly the water required to maintain large flocks of sheep and cattle.

As a rule, the streams which run south and east from the Drakensberg, and the other ranges which run parallel to or in continuation of that great mountain chain, are less promising subjects for irrigation engineering, on a large scale. They

ally have a course of steeper gradients, and n deep and comparatively narrow valleys. ven on these, there is ample room for the ible expenditure of a large amount of capital. ne, attention has already been directed, as to nday River, between Port Elizabeth and Graown. The Breede, the Berg, the Oliphants and many others which might be named, flow h a country covered by valuable farms, the of which might be far more than doubled by nsive irrigation works on a comprehensive though very little has as yet been done to dvantage of the natural resources which these is afford.

e does not admit of more than a very brief ption of the various breeds of cattle. There are native breeds which have valuable qualities of own. The small and hardy Kaffir and Zulu are valuable for their meat and milk. The Dacattle are of larger size, and have larger horns, aching more nearly to the Africander breeds, appear to be a cross between European—bly Dutch—cattle and those which were found possession of the Hottentots when the Dutch rrived in the country. Of late years much en done, with some success, to introduce the valuable and improved breeds of Europe. ost large farms of the more intelligent class mers, some of the best English breeds have ried, with varied success. Shorthorns, howexcellent in other respects, are rather less , and more delicate in constitution, than the of the country. Alderney and Kerry cows nerally to be found near large towns, where s in demand; but with very few exceptions, hardly be said that any very systematic pts have been made to improve, by crossing, breeds which experience shows are most ble in the country. It must be remembered t present, and probably for some generations me, the quality of cattle for draught will ially influence the views of the South African breeder. Railways will, I trust, rapidly d, and the horse and mule wagon will come ncreased use; but the ox wagon is, in so respects, adapted to the country where no made roads are to be found, that it will be a ime before it is entirely superseded by quicker s of transport.

ses.—The Cape has long been celebrated for cellent quality and cheapness of its horses. appear to have been originally of Spanish, or stock, and in this respect resemble the s of South America; but, for some time past, specially since Lord Charles Somerset was nor, great efforts have been made to imthe original breeds, by means of importaof the best English stock. Most parts of the olony, except the warmest of the coast disseem admirably adapted by nature for horse ing. Breeders from Australia, as well as England, generally object to the small nt of shelter and artificial food which is ed to the mares and colts, and consider that ape system of treating breeding stock is rough and less artificial than they would ve. I do not pretend to pronounce any n myself on this point, but any visitor to ape who may wish to see horse-breeding on e scale, as managed by some of the most intelligent and successful of Cape stock-breeders, should apply to Mr. Melk for permission to visit his farm on the Berg River, about 90 miles to the north of Cape Town, where they would have opportunities of seeing South African cattle-breeding in its greatest perfection.

The Cape Colony was almost entirely swept of its best stock of horses by the demands consequent on the Indian Mutiny in 1857, when a great number of horses of the best breeds were exported to India. A time of considerable agricultural depression followed, and it can hardly be said that Cape stock has yet recovered from the depletion of 24 years ago; but this is more owing to the enormous demand caused by purchasers from the interior than from any falling off in the production of stock. The establishment of the Orange Free State and Transvaal republics, and the opening of the Diamond Fields, greatly increased the former demand for horses in the interior, and to this, more than to any falling off in the production, must be attributed the present scarcity and dearness of horses in the best breeding districts of South Africa.

Mules are, in some respects, even better adapted for purposes of draught than either oxen or horses in South Africa, and increasing attention is being directed to the breeding of this kind of stock, but it does not yet meet the demand, and many hundreds of mules are annually imported at present from South America.

Sheep are, as in Australia, one of the staple resources of the South African farmer. The sheep of the country is, as I need not tell you, a very different animal from any European breed; long-legged, with hair instead of wool, and with the enormous fatty tail which distinguishes many of the African breeds of sheep. It must be a very ancient breed, for I have seen onyx images of the black-headed Berbera sheep which is common in North-East Africa, the black head and white body of the sheep being imitated in the black and white of the onyx. These images were found in Egyptian mummies at least 2,000 years old, and resemble the sheep put on board the P. and O. ships at Aden. The Hottentot sheep has its merits, owing to its extreme hardiness and power of resisting privations of food and water, which would destroy almost any other breed; but, except for its meat and its skin, the Hottentot sheep is of little value as compared with any European breed. Men are still living who have had the honour of introducing Merino sheep, or some cross from Merinos, into their own district, and good stories are still told of old-fashioned farmers who, on the first introduction of the Merino breeds, derided the foolish adventurers who offered to pay them for the privilege of "cutting the hair off their sheep;" but such stories relate to a past generation, and at present every South African farmer is alive to the value of his wool-bearing sheep, and keen in discussing the best means of improving them. There is, however, a great want of scientific intelligence among many sheep-farmers as regards the diseases of sheep, the evils of overstocking, and of too frequent shearing, careless breeding, and insufficient shelter and food at lambing time. The Cape Colony is still behind Australia in the attention it has paid to the prevention of scab, by enclosure laws,

Scab Acts, Acts for the extirpation of burr weeds, such as the *Xanthium spinosum*, and other legislative provision for protecting the improving sheep-farmer from the results of his neighbours' carelessness or ignorance. The water supply is a question, of course, of primary importance to the sheep-farmer, and increased attention is every year being paid to means of providing water for sheep pastures by well-sinking and pumping. There are probably millions of acres in South Africa which might be turned into profitable sheep-walks by the irrigation engineer, the well-sinker, and the English manufacturer of inexpensive means of raising water by machinery.

Angora goats are, I believe, of comparatively late introduction, the first having been brought to the colony by Mr. Mosenthal. They appear to thrive in most of the drier climates of the colony, and this branch of industry is likely to receive annual development as the means of transport in the colony improve.

Ostrich Farming.—Time does not admit of my saying more than a few words on this new and most profitable branch of industry. It is but a very few years since the idea of taming the birds which thrive wild in most parts of South Africa, occurred to an intelligent colonist, and when I first went to the Cape, ostrich farming was still looked upon as rather a fancy occupation, not quite worthy the notice of a steady-going, old-fashioned farmer; but the extraordinary profits which have since been realised, have produced a kind of mania on the subject, and in every part of the old colony ostrich farming is very rapidly extending. I have seen some farms where the stock was obtained quite recently by securing broods of wild birds accidently found on the estate; but the production of eggs, and the hatching young chicks for sale, is now a recognised branch of farming industry in almost all parts of the western province. There are very few parts of the country which are naturally unfitted for rearing ostriches, and there are some districts, such, for instance, as the extensive unreclaimed bush lands to the north and east of Grahamstown, which appear peculiarly adapted to ostrich farming, and which have hitherto been almost unprofitable for anything else. The birds require, probably, less artificial food than any other stock of equally productive value. Cuttings of prickly pear, the great white arum, almost every kind of succulent vegetable, maize, and millet, besides the natural food they find at large, appear to suit them, and if they have ample space to move about in, they seem very little liable to artificial diseases. To watch them, to hatch the eggs, and to rear the chicks, require very little more than the ordinary constant attention which would be needed for looking after domestic poultry, while the returns, whether from eggs, young birds, or feathers, are very great with reference to the proportion of outlay, either of land, capital, or labour. But, like every other kind of farming, to render it a success, it requires careful and continuous, patient, personal attention, and many young adventurers whom I have seen going out to Africa expecting to invest a few hundred pounds in ostrich farming, and to live like gentlemen on the proceeds, without care and trouble to themselves, are, I am afraid, doomed to disappointment. I must refer to published works for detailed description of the manugement of the birds, which is full of interest and amusement to those who are fond of domestic animals. I will only notice one peculiarity of ostrich farming, that when tried on an exhausted sheep-walk, it is found that a few years of use as an ostrich run restores land which has been exhausted by over-stocking, and renders it again capable of feeding a suitable number of sheep. I have often been asked whether I thought the present demand for ostrich feathers would last. I could only reply that the liking for such feathers was one of the few points on which the taste of the most barbarous savage agrees with that of the civilized races; that a perfect ostrich feather, like a good precious stone, is a beautiful thing in itself, and that the fashion for wearing ostrich feathers has endured among great people for more than 4,000 years, as is shown by the sculptures of Assyria and the paintings of royal tombs in Egypt.

Before leaving the subject of stock breeding, I would ask attention to the hope, which seems justified by the success of ostrich farming, that the science and patience of some future South African agriculturist may turn to account the good qualities of some of the indigenous animals, which are fast disappearing from South Africa, and also enrich the South African farmer by further importations of foreign domesticated animals. For instance, there can be little doubt that wherever the African buffalo thrives, there the Indian buffalo, which is so valuable for milk, and for heavy draught, and so inexpensive to keep, would be found to thrive; and it is more than probable that if proper pains were taken, the African buffalo, or a cross from it, might be domesticated. There are also, among the llamas and alpacas of America, and the wool-bearing goats of Europe and Asia, other animals besides the Angora goat which would be found profitable. I am aware that experiments have already been made in this direction, but as far as I could learn, they failed, not from any natural incapacity of the country to support the imported animal, but from some defect in management.

So, with regard to camels, there can be no doubt whatever, I think, that the Arabian or Asiatic camel would thrive quite as well in South Africa, as it does north of the Sahara Desert and in Somali-land, and would be a most valuable addition to the means of transport in many parts of South Africa. I, myself, made an attempt at importation; owing to its arrival at the rainy season, and the impossibility of attending to the animal after its arrival, the attempt was not successful; but nothing could be better adapted to the camel than most parts of the Karroo country, which I have seen, and it would probably be still more valuable in the sandy tracts near the Kalahari Desert, and north of the Orange River.

Attempts have been already made by the Khedive of Egypt and Colonel Gordon, to utilise the elephants of northern Africa, as they were, no doubt, made use of by the Carthaginians and Romans. The king of the Belgians has spent large sums in similar attempts in Central Africa. The African elephant is fast disappearing. In the old Cape Colony, a few are still carefully preserved in the forests round Knysna, where H.R.H. the Duke of Edinburgh shot one, and in the Adda Bush

etween Port Elizabeth and Grahamstown; but it is ırther to the northward, I think, that it might be 'orth the while of enterprising speculators, as well s of the Government, to make experiments on a ırge scale, with a view of ascertaining whether ıe indigenous aboriginal elephant could not be ıade as useful for purposes of carriage and raught as in India or Ceylon. I have heard from olonial hunters well authenticated stories of the estruction of scores of elephants at a single battue, when they had been driven into deep marshy ground on the borders of Lake N'Gami; and not a wild elephant is now to be found within many hundred miles of the places where, within my own memory, Sir William Harris and Gordon Cumming saw elephants in herds to the number of hundreds in one day. There are parts of the present colonies where, no doubt, a tamed elephant might thrive and be profitably used, and from the Tugela northwards there is probably very little of the coast country where they would not supply, to a great xtent, the present want of efficient means of arriage.

It may not be out of place that I should mention ıe possibility that some of the less productive arms may, at no distant period, be turned to ccount as game preserves, like the red deer rests in Scotland. I know gentlemen, such as Ir. Alexander Vanderbyl, who have enclosed romontories on the southern coast, containing me thousands of acres, where they have preserved the indigenous antelopes of the country, nd can offer a day's shooting, comprising at least x kinds of African antelope, besides the partridges, ıstards, and pheasants, as they are called, of the untry. The bush-buck, the rai-buck, and the niker appear, wherever a tract of bush is allowed rest without much intrusion from woodcutters. he spring-bok appears periodically in such multiıdes, in the districts bordering on the Orange iver, that I have seen applications to Government ıat the farmers might be allowed to destroy the ucks in the close season, as a means of preventing heir eating up the sheep pasture; almost every pecies of African antelope will thrive and multiply ı enclosed tracts, if only preserved from destrucion by the sportsman.

Time does not admit of more than the briefest ossible allusion to the resources for arable farmng in South Africa. As a general rule, it may be aid that, with the exception of garden lots, very ew farms are cultivated to the full extent of which they are capable. This is partly owing to he abundance of land, partly to the old colonial ove of isolation, and partly to the want of adequate supplies of capital and labour. But on every hand are seen evidences of progress and improvement. The old Dutch plough, and the old fashion of trampling out the grain, are giving way to the newest ploughs by Ransome, Howard, and other European and American makers. The steam plough has been imported and used. Many farmers in the western provinces use reaping and thrashing machines, and mowing machines have been introduced into Natal. But these things are to be seen only here and there, at rare intervals, and only a beginning has been made of improved farming on scientific European systems.

It is very rarely that an attempt has been made to meet the uncertainty of the seasons, by saving hay or roots for feeding cattle, though in most parts of the country oat hay is cut and stored for forage. But a very large field is open for improvements in all these branches of farming.

So with regard to cerials. On wheat-lands the the finest crops of wheat are apt to suffer from rust, but I doubt not some scientific farmer of the future will introduce kinds less liable to this disease.

Millets in all varieties seem at home, as well as Indian corn—or "mealies"—in every part of South Africa, but some of the best kinds of Indian and American origin have not yet been tried.

Vines are among the established agricultural resources of the western colony, but little has been done to improve on the old methods of vine growing and wine making brought to Africa by the original settlers.

In Appendix E will be found a memorandum, with which I have been favoured by Mr. Goodliffe, describing steps lately taken for the improvement of wine farming and wine making in the Cape Colony; and I have no doubt that a new era is before the South African wine grower, more especially if the wine duties in England are remodelled on the principles lately recommended by the Select Committee of the House of Commons.

The fact that Cape wines gained prizes at the late Paris Exhibition shows that, when properly managed, they will yet bear comparison with European vintages.

We have yet to notice many valuable articles of semi-tropical produce, for which the warmer regions of temperate South Africa are well adapted. Natal has already established a name as capable of producing coffee and sugar. Of coffee, the crop in 1870 was 960 tons; since then the production fell off, chiefly owing to want of experience and knowledge of the best mode of treating the plants, and is only now again on the increase. The causes of this temporary decline will be found described in a memorandum, with which I have been favoured by Mr. Walter Peace, the emigration agent for Natal, and which is annexed as Appendix (F).*

For details regarding the production of sugar, I must refer to the same paper by Mr. Peace. It is said that the last crop will yield 15,000 tons of sugar, of an average value of £20 per ton.

I cannot give a better account of the agricultural resources of Natal, than by quoting the annexed extracts from the address of Mr. W. G. Baker, president of the Pietermaritzberg Agricultural Society, at the annual meeting of that society, in October last, for which also I am indebted to Mr. Peace.*

It will be seen that tea planting has also been tried with success, and that all the smaller articles of semi-tropical produce, such as red pepper, tapioca, and arrowroot, afford profitable returns.

Tobacco is already grown to a great extent in Oudtshorn and other districts of the Cape Colony, and on most good farms in the warmer portions of the Transvaal. Looking to the great and increasing consumption of tobacco in all parts of South Africa, among natives as well as Europeans, there may be no doubt that tobacco may become a great staple of South African agricultural industry.

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* *Vide* Appendix F.

On the great value and necessity for tree planting on an extended scale, and of the immense benefit which a good system of forestry would be to South Africa, I cannot now dwell, nor on many minor resources of industry connected with agriculture, such as the abundance and value of fruit crops of almost every kind suited to a temperate climate, the drying and preserving of which afford profitable occupation to many upland farmers.

Turning now from the land to the ocean, I can only briefly glance at the resources afforded by the fisheries on the South African coasts.

Table Bay, and False Bay, as well as Algoa Bay and Saldanha Bay, were formerly great resorts of whalers, but of late years, this branch of marine industry has fallen of, and though whales are still abundant in the seas of South Africa, the whole fishery is confined to an occasional American ship, the master of which does not always devote his exclusive attention to whaling. The seal fishery also has disappeared, though seals still visit in small numbers the rocky islets in the neighbourhood of the Cape; but there is a large and increasing demand for the fish, which are caught and cured in great numbers in the neighbourhood of Cape Town, as well as along the coast to the northward, and form a large item of export trade to the Mauritius and other places.

On the West Coast, north of Saldanha Bay, there are but two ports at present frequented by sea-going steamers, Walwich Bay, on the coast of Damaraland and Port Nolloth, the port of the copper mining district, just south of the Orange River. Neither affords complete shelter to vessels of any considerable size, nor could either be improved in this respect without the expenditure of a considerable sum of money; but there can be no doubt that much might be done to improve the facilities of landing and shipping on this coast, if it were carerully surveyed, and the natural landing places improved by beacons, lights, and similar appliances.

Harbours.—The coasting as well as the ocean-borne trade of South Africa has been much restricted by the want of good natural harbours. All the large rivers have bars at their mouths, which prevent their being much used for purposes of trade, and, from the Portuguese frontier on the West Coast, in lat. 18°, round to Delagoa Bay on the East Coast, in lat. 26°, with the exception of Saldanha Bay, there is not a single perfectly safe natural harbour where large ships can lie at all seasons, and take in or discharge cargo without inconvenience. Saldanha Bay will, no doubt, in time, be connected with the railway lines in the vicinity of Cape Town, and will become a valuable port. At present, it is hardly ever used, except as a quarantine station. Table Bay is an anchorage secure from easterly and southerly winds, but open to the north and west. Its natural defects in this respect have, however, been, to a great extent, supplied by the breakwater (the first stone of which was tipped by H.R.H. the Duke of Edinburgh in 1860), and which is still in progress of extension. It has already rendered the anchorage safe against the dangers which, in former years, have strewn the coast of Table Bay with wrecks of large vessels. The Alfred Docks have supplied the means of receiving and discharging cargo, alongside a wharf, to all but the very largest class of shipping, and even these will, at no distant period, be accommodated by the extension of the docks and jetties now in progress. Graving docks, slips, and other appliances are also either completed or in course of completion. It is only necessary to carry out the designs of Sir John Coode, in order to enable Cape Town to take its place as a port furnished with every desirable convenience for mercantile marine.

Simon's Bay, an inlet on the shore of False Bay on the other side of the Cape peninsula, is an anchorage safe at all seasons and in all winds for ships which are well found in ground tackle and it has the appliances of a small naval arsenal, but it is deficient in the necessary means for cheap and rapid discharge of cargo, and is as yet unconnected with Cape Town by railway, though only twelve miles distant from the present terminus.

Algoa Bay is an open roadstead, owing its facilities for carrying on trade to its excellent anchorage, and for putting to sea should it come on to blow heavily from the exposed quarters. Everything which enterprise can do has been done to facilitate landing, short of the construction of harbour works, and these, I trust, will not be long delayed, for it is evident to anyone who has paid much attention to harbour improvement that there is an existing trade at Port Elizabeth which would justify such an outlay as is estimated for the improvement of the harbour; and there can be little doubt, from the high character of the engineer, that any sums laid out on the completion of Sir John Coode's plans would be well applied.

Port Alfred, at the mouth of the Kowie River, is a bar estuary, which is being made available for sea-going ships of moderate burden by works which will make this a very useful port.

The same may be said of East London, at the mouth of the Buffalo River. There seems no reason to doubt that Sir John Coode's plans for the improvement of this estuary will be successful, and make it a valuable port for all the Kaffrarian frontier.

The St. John's River, in Pondoland, is a natural estuary, requiring, apparently, harbour works of no great extent, or probable expense, to render it a most useful channel of trade, but the surveys for its improvement have only lately been completed, and no plans have yet been laid out for the harbour works needed to make the bar passable. The anchorage inside is of great extent and perfectly sheltered.

Durban, in Natal, is already a port carrying on a very large trade, though the harbour is readily accessible only to small sea-going vessels; and little progress has been made in removing the bar, which would enable it to accommodate large vessels. These are at present obliged to remain outside, and discharge and receive cargo as in an open roadstead. Various plans have been devised for the improvement of the Durban harbour, and large sums have been expended, with very little effect, chiefly because it is only lately that the authorities have consulted an experienced harbour engineer, with a view to the systematic and perfect improvement of the harbour. Sir John Coode has furnished plans which, I have reason to think, would be approved in all their main features by his professional brethren, and there can be no doubt that Durban might be made an admirable harbour, adapted to

sea-going ships of the largest class, by works not more expensive than those which have converted the port of Kurrachi, in Scinde, from a small coasting port, a little better than a fishing village, into one of the principal ports of the Indian Empire. The resemblance between the two harbours is most striking, and having watched the Kurrachi harbour works from their commencement, and seen the general improvement of the harbour, I cannot but regret the delay which has hitherto occurred in acting upon Sir John Coode's recommendations with regard to the port of Durban.

Delagoa Bay is a good natural harbour, where ships of any size may load and unload in safety, even in the present unimproved condition of Lorenzo Marquez, the seat of the local Portuguese Government. The port is admirably situated for the wants of the Northern and Eastern Transvaal, besides a great extent of fertile coast country in its immediate vicinity. The Maputa River, running south from the bay for 60 miles as the crow flies, in the direction of Zululand, gives valuable water-carriage to Tongaland, whence large numbers of labourers come to work in Natal and the Cape Colony. Other rivers, which discharge into the bay, afford similar facilities, to a less extent, in other directions, the land all around being extremely fertile, and well adapted for sugar and rice. It requires only a settled government, able to protect life and property, for its development. It is a standing cause of complaint with many of those who are anxious for the progress of South Africa, that this harbour was awarded to the Portugese by arbitration. but I would put it to those who wish for the development of trade in this direction, whether it would not be better that we should avail ourselves of the advantages held out by the Portuguese port, rather than indulge in unavailing regrets that the port does not belong to ourselves? Nothing can exceed the liberality of the terms of the treaty concluded by Mr. Morier, H.M. Minister at the Court of Lisbon, with the Portugese Government, and the treaty would probably have been ratified and made use of ere this, had the English mercantile community, who are interested in the development of those countries, shown that they appreciated the advantages held out to general commerce by the treaty, and pressed her Majesty's Government for an early ratification of the treaty by both Powers. The treaty provides that British goods should be admitted free of custom dues in bond; that the English Government should be allowed to build bonded warehouses to any extent; to connect such bonded storehouses by rail with the frontier of the Transvaal; and so to import goods free of Portugese customs through the Portugese territory. No greater facilities in these respects could be afforded if the port were in our own hands, and, judging from what is done elsewhere, there would be no insuperable difficulty in obtaining from the Portugese Government such additional improvements in the facilities for landing and shipping goods at Lorenzo Marquez as English traders might require.

Before quitting this subject of harbours, I would note that I have enumerated only those which are already open to ocean trade. There are others which might be improved at no great expense, and will, I have no doubt, at no distant period, be thriving ports for a considerable local and coasting traffic. Some, like Mossel Bay, are good roadsteads, where a large and increasing trade is already carried on, though the means of landing or shipping cargo depend on the weather. Others, like the Knysna, are already accessible as far as depth of water is concerned, and are well sheltered, but require better communication with the interior through the mountain ranges which encircle the harbour, and such appliances as a good steam-tug, to make the narrow entrance safe for sailing vessels. Others are bar harbours, like the Berg and Breede Rivers, and are at present frequented by small coasting vessels, but might be made accessible, with a considerable amount of inland river navigation, by such works as have rendered so many of our own bar harbours in England available to ocean commerce. But it is only within the last few years that the commercial public in South Africa has been awake to the necessity for such harbour works. I have no doubt that every year will witness further improvement in this respect, bearing in mind the cardinal truths which apply to harbour improvement in every part of the world, that it is waste of money to follow any but the best scientific advice; that the best scientific advice always makes the utmost possible use of natural forces as means of gradual improvement; that all permanent improvements must be gradual, and that no great improvement can be expected, until the whole of the works designed for removing obstacles by the scientific engineer have been completed.

Steamer Lines.—I need not dwell at any length on the great development of steam communication with the Cape, the history of which would alone afford ample materials for a long lecture. It is sufficient to note that the companies of Messrs. Donald Currie and the Union Company each run during the greater part of the year a large steamer every week, and sometimes two, between the Cape and England, the lines from the Cape being extended to the Eastern ports as far as Delagoa Bay.

While on this subject, I would notice the great field for development of commerce on the western coast, which would be opened by the employment of steamers between Table Bay and the Portuguese possessions. There is already a line of steamers, subsidised, I believe, by the Portuguese Government, and managed by a Hull Company, between England and Benguela, the southernmost port on the west coast belonging to Portugal.* There is already a growing traffic, which affords employment to a small steamer between Cape Town and Walwich Bay. Much more might be done, if the service were more regular, and carried on by better steamers. Even with the present amount of traffic it is probable that a line on this coast would find ample employment, and still more, should a land line of telegraph be carried through Damaraland and the Portuguese possessions as far as the Congo, on the West Coast.

Telegraph Lines.—I cannot here do more than advert briefly to the increasing facilities for commerce afforded by the development of telegraphs. The ocean cable has been lately completed between Durban and Aden, and the network of land lines.

* Vide Appendix G.

has now extended to most of the towns and larger villages in British South Africa.

Railways.—As regards railways, also, I can here only briefly state a few salient points. The total length of lines at present open, or likely to be opened in the course of the next few months, in the Cape Colony, is 959 miles of Government railways, and 98 of line made by the Copper Mining Company. The lines are shown on all the modern maps of the colony, and extend (1) from the Cape Peninsula to Beaufort West; (2) from Port Elizabeth to Graaf Reinet, with one branch to Grahamstown and another to Craddok; (3) from East London to Queen's Town. All these lines are likely to receive early extension from their present termini, till they converge and reach Kimberley and the Orange Free State, and till Grahamstown is connected with Port Alfred at the mouth of the Kowie.

The Natal lines at present extend no further than from Durban to Pietermaritzberg, with short branches parallel to the coast; one running north, the other south. It is a question locally much discussed, whether the Pietermaritzberg line shall be extended in the direction of Ladysmith and Harrismith, or of Newcastle. The total length of rail completed in Natal is 105 miles.

I understand there is a project for a line in continuation of that from Durban to the Tugela, which shall ascend to the east of Zululand, through the country under Mr. John Dunn's chieftainship, so as to tap the coal-fields in that direction.

A line from Delagoa Bay to the Transvaal is of the utmost political and commercial importance, and is not likely to be delayed long after order is restored in the Transvaal. I believe that the extension of the railway system is one of the most potent factors in promoting the peaceful development of all South Africa. The Cape lines hitherto made are paying well, and will, when extended to Kimberley, enormously increase the commercial facilities of the country, without imposing any tax on its finances.

In these brief remarks, I have endeavoured to give to the industrial classes of these islands, through the widely circulated *Journal* of the Society of Arts, some faint idea of the industrial resources of the great country where I have lately sojourned. It is a country with a history, but a history confined to the deeds of men, our kinsmen in blood, and almost of our own times. Many thousand years must have elapsed since the South African continent took its present shape; the great basin of the Orange River and its tributaries, with their diamond fields and gold fields, their deserts, and their fertile pastures; the rock-bound coast; the great mountain ranges, which rise to the Drakensburg peaks, all were, probably, thousands of years ago, as they are now, in outline and climate, in clothing of plant and tree, and in the wild animals which abounded within living memory; there is no evidence of much change in natural form or feature for forty or fifty centuries before Europeans came to colonise. But history there is none of South Africa—save vague traditions, or such records of pre-historic man as bone caves and gravel beds may yield—till we come down to the days when the bold seamen of Portugal planted the cross on each great promontory as they weathere[d] marked the road by which English, [D]
French traders might follow them to [the]
Indies.

The country has, however, a great his[tory before]
it, but it is a history yet to be made by [men of]
European lineage, who have chosen it as [their home.]
As the traveller passes over league afte[r league of]
almost uninhabited country, and marks [the fertility]
of the soil, the genial climate, the [facility of]
access, and the ease with which all the [appliances]
of civilised European life can be su[pplied, the]
questions force themselves on him, how [long is this]
land, so favoured by Nature, to remai[n un-]
inhabited by civilised man, the herita[ge of wild]
animals, or the abode of a barbarism [which de-]
grades mankind almost to the level of [the beasts]
that perish?

And then it was impossible not to t[hink of the]
thousands of civilised, industrious, l[aw-abiding]
men and women, who, in our nort[hern over-]
populated country, are wearing out t[heir lives in]
a ceaseless struggle for a bare existen[ce, and it was]
difficult to resist the conviction tha[t here, in]
South Africa, was ample room for m[any]
myriads of such men to find the mean[s of living]
and of rising to comfort and independ[ence, which]
are daily becoming more difficult of [attainment]
within the narrow limits of our own la[nd.]

But for such men as I have describe[d, who]
resolve to make South Africa their hon[me, there is,]
I believe, a higher destiny than merel[y]
even than helping to form a nation.

Thinly scattered throughout the w[hole country]
are tribes of various native races, on[e of whose]
peculiarities seems to be that they [have never]
settled, never had a resting-place, in [any land]
which, for many generations together, [they could]
call their own. They have no histor[y, but a]
memory of endless migrations, pursui[ng and]
pursued; as conquerors and extermin[ators, or as]
the victims of conquest and extermin[ation. The]
oldest or most intelligent can but repe[at the]
dreary memories of how they came [down]
from the northward—from regions [where they]
were a greater, more civilised, and ha[ppier people]
than they are now; how, driven o[n by other]
hostile tribes, they sometimes rested [for]
generations in the same region, and, [by virtue]
of superior courage and sagacity, [they]
slaughtered, drove out, or absorbed [the weaker]
clans, only to be in their own turn [driven out,]
slaughtered, or absorbed by some yet s[tronger or]
more numerous savages; or driven [from their]
temporary homes, to resume the ceasel[ess wander-]
ings of thousands of years past.

Yet are they a people of excellent, p[hysical and]
intellectual qualities, many of them fa[r above]
the negroes of Central Africa, and all b[earing more]
or less traces of having been gradual[ly degraded]
from a state of higher civilisation and [more com-]
plete humanity. They are capable [of learning]
and adopting all that we can give [them of the]
arts of peace, the means of civilisatio[n, and those]
great truths which are the secrets [of national]
and individual happiness here on ea[rth, and the]
only sure lights in the darkness and [doubt of a]
future existence. I have known m[en of these]
native races, endowed with natural [abilities]
in no way inferior to the averag[e]

› make their mark in intellectual or political pers even amongst ourselves. These are ir capabilities. What is needed for their elopment? Nothing, I believe, but settled er and government—of our modern European lised type—a Government that can frame s, and enforce them, which can defend and property, and enable its citizens, as long hey obey the law, to prosper and advance in sation and happiness, each according to his r individual qualities.

uch Governments already exist in South Africa. ave nowhere seen a Government which reprod as fully and accurately as that of the Cape ony, the conditions and possibilities of social political life, which we so value here in England. h Government is possible under the English g, in every one of the South African States out exception; and under such Government son of toil from this country may live and sper, in amity with his fellow-subjects of every ; and in such Government all may have their share, as subjects of the British Crown.

here was a time, so historians tell us, when ote Aryan ancestors of our own swarmed forth n Central Asia, some towards India, others ards Europe, north and south, to occupy the e places of the earth, and to become in the e of long ages the parents of great and ed nations. A swarming of the same kind set nerations ago, from our own land, and has on increasing till America and Australia ise Northern Europe as the parent of us and growing nations which had no ce when the Cape of Storms was first l. South Africa is later in the field as a home grants, but with capabilities to receive the undant myriads of Europe for many generacome.

ative races, which have so long been reas insuperable obstacles to the progress of the country, will, I feel assured, at no distant period, be acknowledged as valuable elements in South African nationalities; for, in South Africa, I believe, the Government is ever anxious to act in accordance with the great truth which Englishmen have never been slow to recognise—that our duty with regard to races, inferior to our own in civilisation and power, is to do to them as we would have our Government do to us—to rule and protect them; to teach, to guide, and elevate them; and not to enslave or exterminate them.

APPENDIX A.

METEOROLOGY.

The best account of any South African climate I have seen will be found in a full and comparatively late, as well as most interesting. chapter on the Natal climate, at pp. 59 and 105 of "Brook's Natal," edited by Dr. Mann, and in the chapter on climate in "Mann's Colony of Natal," pp. 47 and 69. It is much to be desired that similar papers were procurable, giving a scientific account of the climate of the other natural divisions of South Africa.

Much information on the climate and meteorology of South Africa will be found in Silver's "South Africa," 3rd edition, pp. 195 and 215 to 357 (Basutoland); for Natal, pp. 411 and 416; for Orange Free State and Bloemfontein, p. 457; also in the Cape Directory for 1880, p. 51 and p. 444 (on Natal), and p. 474 (on Transvaal); also in the "Emigrant's Guide," p. 79.*

The paper referred to in the following extract from the *Colonies and India* for December 11th, 1880, will probably be found to contain much that is needed in drawing up a good sketch of the climate of the Cape Colony:—

"THE RAINFALL IN SOUTH AFRICA.—At the opening meeting of the present session of the Meteorological Society, held on the 17th ult., at the Institution of Civil

* But there are so many variations in different provinces as regards all that relates to climate and meteorology that no general sketch can do justice to the subjects.

ct of Weather Charts from December, 1876, to December, 1877.—Grahamstown, South Africa.
Height above the Sea Level about 1,790 feet.

s.	Thermometer.									Barometer.			Rainfall.	Remarks.
	Average.		Greatest.		Least.		No. of days upon which the maximum registered		Greatest observed heat in the sun.					
	Maximum.	Minimum.	Maximum	Minimum.	Maximum.	Minimum.	90° and upwards.	80° and upwards.		Highest.	Lowest.	Average.		
......	74·7	58·0	87	62	63	43	none	12	117°	28·17	27·63	27·90		The readings of the thermometer give the registered maximum and minimum in the shade, the site being on a shady wall of a house, and under a verandah. These, and the readings of the barometer, were taken at 9 a.m. The observations of the greatest heat in the sun were usually taken between 1 and 2 p.m. from an ordinary thermometer mounted on box-wood, and hung on a dark painted pale of a garden railing facing north.
......	79·3	60·0	101	71	63	51	4	17	134	28·20	27·80	28·00		
......	79·1	59·6	89	66	63	52	none	14	120	28·10	27·70	27·20		
......	79·3	61·9	90	71	65	55	2	15	114	28·30	27·65	27·97		
......	73·7	55·6	87	65	61	43	none	9	118	28·30	27·60	27·95		
......	65·0	49·0	78	54	54	42	none	none	110	28·20	27·60	27·90		
......	61·8	48·9	72	61	51	42	none	none	112	28·35	27·75	28·05		
......	65·2	51·4	82	57	56	41	none	1	no record	28·50	27·95	28·22		
......	67·7	52·3	80	63	60	41	none	1	108	21·62	28·10	28·36	0·805	
r ...	69·2	47·4	92	60	56	40	2	4	114	28·68	27·78	28·23	1·231	
......	75·6	54·0	97	71	61	44	3	9	105	28·46	27·72	28·08	3·059	
r......	73·8	57·4	88	66	58	48	none	9	110	28·48	27·73	28·12	1·213	
......	81·3	60·1	99	68	64	51	6	18	119	28·40	27·70	28·05	0·492	

—* On the 6th, 7th, and 8th of July, there were no readings. No observation of the maximum and minimum thermometer the 1st and 8th September (inclusive). Observations during September, October, November, and December were taken at , which is about 1,250 feet above the sea level.

Abstract of Weather Charts from January to December, 1878.—Grahamstown, South Africa.
Height above the Sea Level about 1,790 Feet.

Month.	Thermometer in Shade. Average. Maximum.	Average. Minimum.	Greatest. Maximum.	Greatest. Minimum.	Least. Maximum.	Least. Minimum.	No. of days on which the heat in the shade exceeded. 90°	80°	Barometer. In Inches. Highest.	Lowest.	Average.	Rainfall. In Inches.
January	82·6	61·6	105	69	70	54	14	23	28·36	27·93	28·14	0·43
February	77·2	60·3	91	66	63	54	2	12	28·48	27·86	28·17	2·44
March	75·4	58·0	95	69	55	45	1	8	28·43	27·95	28·69	2·55
April	75·2	55·2	90	63	63	42	1	6	28·59	28·12	28·35	1·44
May	68·0	49·0	82	61	57	39	none	3	28·56	27·99	28·28	1·02
June	63·7	45·2	73	51	47	37	none	none	28·67	27·98	28·33	1·47
July	62·6	43·6	78	58	52	36	nono	none	28·57	27·96	28·26	1·01
August	60·8	42·2	80	50	47	32	nono	1	28·73	28·16	28·44	1·99
September	68·7	49·2	91	59	50	35	1	4	28·60	28·10	28·35	2·76
October	74·8	50·4	87	58	61	43	none	9	28·50	27·61	28·05	0·58
November	72·9	58·0	105	63	62	47	4	13	28·47	27·92	28·40	2·72
December	77·2	56·0	107	68	64	47	6	16	28·40	27·85	28·13	1·81
												20·22

Engineers—Mr. G. J. Symons, F.R.S., president, in the chair—a paper was read by Mr. John G. Gamble, F.M.S., on "The Rainfall in South Africa." The author gives the monthly totals of rainfall from 103 stations for the thirteen months, December, 1878, to December, 1879, and also the monthly means from all stations in South Africa from which a record of five years or upwards could be obtained. It is shown that the Cape Peninsula, the South-West, and the West Coast have winter rains with a dry summer, characteristics of what is called the sub-tropical region, the rains coming with the north wind or anti-trade; while Natal, Aliwal North, and, in a less degree, Queenstown, have the tropical features of a wet summer and a dry winter. On the South Coast the rainfall appears to be more equally distributed throughout the year, though there seems to be an October maximum at Port Elizabeth and Uitenhage. In the Central and Northern Karoo the maximum of the very scanty rainfall occurs in February and March. These rains generally fall in thunderstorms, each storm seems to come from a westerly direction; but it is a more or less well ascertained fact that these rains do not fall up country until the south-easters have set it on the south and south-west coasts. In the south-east of the colony the transition towards tropical features may be noticed, both Grahamstown and King Williamstown showing a winter minimum in June."

Writing from 2, Garville-avenue, Rathgar, Dublin, December 15th, 1880. Mr. Charles G. Napier, who paid much attention to the meteorology of Grahamstown, says:—

"I send you enclosed the abstract of the weather charts for Grahamstown, 1878; you will see on comparison that they do not very much differ from those for 1877. I have also a slip out from one of the Grahamstown papers, by which it appears there fell there in 1875 21·60 inches of rain, and in 1876, 26·81 inches of rain.

"P.S.—The weather charts for 1878 were kept by Mr. Felix Cornual, formerly my clerk. I think he is still in Grahamstown, and has more information on the subject, as also have I. They kept, and I believe still keep, weather charts in the Albany Hospital, Grahamstown. Mr. John E. Davis, the superintendent, used to *keep them.*"

APPENDIX B.

Public Income and Expenditure.

As regards the Cape Colony and Natal, it is difficult to condense the abundant information contained in Blue-books better than is done in the Directories for each colony, referred to in the lecture.

The following information regarding the Transvaal has not, I believe, as yet, been published in this country:—

Transvaal Finances.

The annexed extracts from the Transvaal Government *Gazette*, of the 6th December, give the latest information regarding the financial position of that territory, as contained in the financial statement for 1880-1, laid before the House of Assembly, Pretoria, on the 30th November, 1880, by Mr. C. E. Stafford Steele, Financial Commissioner and Acting Colonial Secretary. It will be seen that from £70,000, which was considered a high estimate, after the annexation, the revenue has risen to £160,000, chiefly owing to the better realisation of the old taxes. No new taxes have been imposed. Some objectionable imposts, such as the war tax, have been remitted, and something has been done to reduce debt.

Extracts.

"The revenue estimated for 1880 was £159,658, and the expenditure £153,751, leaving an anticipated surplus of £5,907. The amounts for next year are £172,300 and £164,234 respectively, which would give a surplus of £8,066.

"Turning to the statement for revenue it will be found that the total for the year 1879 was but £93,4[illegible], whereas during only three quarters of the current year £133,394 have been received into the Treasury against the twelve months' estimate of £159,658. The expenditure statement shows that £108,574 have been spent up to the end of September against the year's sanctioned expenditure of £153,751.

"Taking the income and disbursements of the nine months ending September, as compared with three quarters of the sums provided for on the estimates, an increase of revenue will be found amounting to £13,6[illegible] and a decrease of expenditure of £6,740.

"Whether the results on the expiration of the remaining quarter of the year will prove proportionately as

vourable as the foregoing is a question which, in a easure, depends on the outcome of the visit of the onourable the Secretary for Native Affairs to the stricts of Waterberg and Zoutpansberg. The collecon of the native hut tax was undertaken at a late te, and a large amount would seem to be still due om the natives in those portions of the Province ecified. Should, however, the collections this year ll short of the sum estimated, I have every hope that ar finances will, nevertheless, be found to have attained fair equilibrium. The forecasts under other heads ave proved to have been so moderate, that unless any extraordinary liabilities be incurred during the remaining portion of the year, I think we may be fairly assured of such a result.

"Political questions have, no doubt, in a measure affected the revenue. The whole of one district (Bloemhof) and portions of two others (Marico and Potchefstroom) fall within what is known as the Keate Award Line, and pending the final settlement of the matters at issue, the payment of taxes has not been enforced within those arrears. It is not surprising, therefore, that the Govenment dues, paid in the Bloemhof district, do not exceed £260.

"Then, again, the Boer agitators are responsible for some portion of the revenue not finding its way into the Treasury. Besides those who refrain from paying, in order to mark their hostility to the Government, there are many who would willingly pay, but do not merely from a lack of moral courage. These latter fear to come forward, but yield to their terror of the opinions of the more violent members of their community.

"I have still to show why a larger sum is anticipated for collection under quitrent in 1881 than that estimated for in 1880, more especially as it has just been proved that only a little more than half the estimated receipts for 1880 were collected from this source. In respect of this I would state that the returns of the Landdrosts were set aside as not being sufficiently trustworthy, and that, in framing this estimate, the conclusions arrived at have been based on statistics regarding landed properties obtained from the office of the Registrar of Deeds. The information so acquired can, I think, be accepted as reliable.

"A few remarks are necessary regarding the railway tax. The receipts during 1880 from this source (both current and arrear) up to the end of September came to £18,500. The amount collected during the whole of 1879 was but £9,496.

"In the early part of this year it was ascertained that the present rate was unnecessarily high for the attainment of the special object for which this tax was imposed. Its reduction was, therefore, determined upon, and a Bill providing for this has recently passed through its third reading in this House. It may be as well to point out that Government cannot afford to remit taxation, and the reduction would not have been made had Government felt itself justified in applying the proceeds of this tax to other purposes than those for which it was created. The charges against the proceeds of the railway tax have hitherto been swollen by survey expenses, payment of claims on material lying in Holland, law charges, and by other miscellaneous items of expenditure connected with Mr. Burgers' scheme, which are not likely to be incurred again. There is every reason to believe, therefore, that, for the future, it will be possible to devote the receipts from this tax solely to the payment of the interest on the debt, and to the liquidation of the principal. For this purpose £7,000 are required annually, and this represents the sum for collection placed on the estimates for the coming year. I should mention that the new law will provide for a possible income of about £8,000. There are, moreover, large outstanding balances still due under this head of revenue, as also the value of material sold, to credit to the railway account.

"With regard to the native hut tax, the amount to be derived from this branch of the revenue continues to be a subject of speculation. The collections were not undertaken much before the month of May, and by the end of September, £13,225 had been paid into the Treasury, a further sum of £7,000 being in transit at the time. The Hon. the Secretary for Native Affairs is personally superintending the working of the law. The three most populous districts have yet to contribute their quota to the revenue; it is possible, therefore, that the anticipations in respect of this tax may yet be realised before the end of the year. It has to be borne in mind, however, that the officials entrusted with the duty of levying this tax are new to the work, and, moreover, that their knowledge of the country has been necessarily limited, owing to the native disturbances, now happily at an end. This ignorance of the country is no doubt taken advantage of, and many evade paying who will not so easily escape next year, when the native commissioners and others become better acquainted with the nature and scope of their duties. Thus, in the absence of any apprehension as to the soundness of the estimate framed for the current year, viz., £35,000, it has been considered safe to place an additional £5,000 to this sum for the estimates of 1881.

"Duties generally are expected to yield a much larger revenue to that hitherto obtained. In 1879, the duties (inclusive of import) came to £54,652. For 1880, they were estimated at £53,103, but at the end of last quarter they had already reached the sum of £57,922. The amount placed on the estimates for next year is £71,670.

"The principal heads under which such a large increase is anticipated are import duty, transfer dues, licenses and revenue stamps.

"On referring to the revenue statements placed on the table, it will be seen that from import duty an increase is expected of £3,850, as compared with the sum estimated for 1880. In 1879, £19,252 were received; during nine months of this year a sum of £17,791 was collected, and for 1881, £22,120 have been placed on the estimates. The unsatisfactory working, and also the somewhat unfair incidence of this tax has not been lost sight of. It is hoped that the approaching settlement of the Keate Award question will enable Government to adopt measures for the prevention and detection of what may be termed the smuggling which, there is ample evidence to prove, is carried on in the south-western districts. The steps to be taken for the better application of the law in other districts is a matter which is at the present moment under the consideration of Government. Fewer evasions of the law are expected, and it is anticipated that the continued prosperity of the country will fully justify this forcast made of the receipts from 'customs.'

"Coming now to 'Duties other than Import,' the chief items calling for remark are transfer dues, licenses and revenue stamps.

"First, to take transfer dues:—

"The estimated amount for the current year is £10,000; the receipts up to the end of September exceeded, however, that sum by £2,280. For 1881, £16,000 have been placed on the estimates. The expectations in respect of this increase are based on more extensive sales of land being anticipated, and on the coming into operation of the new law—XI, 1880. Under the provisions of this law, it is competent for the Receiver of Transfer Duty to cause a valuation of property to be made when the price under which it is alleged to change hands appears inadequate.

"*Licenses.*—In 1879, £8,786 were received under this head. For the current year, £9,125 were estimated; the receipts are about £1,400 in excess of this already. For 1881, £12,000 have been placed on the estimates, and there is every reason to believe this sum will be realised.

"*Revenue Stamps.*—The extension of the principle of

collecting certain items of revenue by means of stamps has been attended by beneficial results. In 1879, a sum of £13,457 was collected in this form; during nine months of this year £13,747 were collected. The somewhat large increase for 1881 is anticipated partly on the grounds stated in connection with transfer dues, and partly in consequence of measures having been introduced in this House providing for fees being levied in certain cases, notably under the Insolvency Law.

"Under 'other receipts' are comprised certain items which amounted, in 1879, to £7,501. During the three-quarters of the current year they amounted to £10,834. A sum of £9,250 has been estimated for 1881. The excess, during 1880, as compared with the figures for 1879, is due partly to increase sales of Government property, and partly to the fact that the receipts of the Telegraph Department are included under this main head. The line having been opened only during the latter part of last year, the receipts for 1880 are naturally considerably greater than those for 1879. Proportionately, however, the receipts do not compare favourably, and there would appear to be a falling off in the work which is not confined to a reduction in the number of Government messages. The revenue from this department, for 1881, has, consequently, been estimated at a sum representing nearly the receipts of the current year.

"The total revenue to be derived under all sources, during 1881, has thus been shown at £172,300, from which an estimated expenditure of £164,234 1s. 6d. has to be met.

"On referring to the statement, it will be found that the disbursements for 1881 are expected to exceed those of the year now drawing to a close by £10,482. According to the analysis of the expenditure given in the statement, there is an excess in the cost of establishments of £14,436. This large excess is, however, not real, as I will proceed to explain. It will be noticed that the classification of the expenditure for 1881 differs materially from that adopted in last year's printed estimates. This modification in the form of the estimates has been followed in accordance with the wishes of the Right Honourable the Secretary of State, conveyed by his despatch No. 33 of June last. In the carrying out of these changes, large amounts, formerly appearing under the separate heads of aborigines, colonial defence, forests, &c., are now embodied under 'Establishments.' The charges appearing under those heads in this year's estimates represent solely expenditure on services exclusive of establishments. A no less sum than £10,800 of the apparent increase is simply due to this alteration in the mode of classification. To the revision of establishments, and of the rates of salary, an increase accrues on last year's estimates of £3,600. This sum is arrived at after deducting the saving effected in certain departments consequent on such revision.

"This scheme, to which the Secretary of State has notified his approval, allows of a permanent increase in salary to ten officers of the Government, and it further provides for additions on the incremental principle to the salaries of twenty-two other officers.

"The sums expended in 1879 on pensions and grants amounted to £1,673 11s. 11d.; for the current year, an expenditure under this head of £1,430 was estimated for; the amount entered for 1881, is £2,150, of which £1,650 only is foreseen. The following are the names of recipients of pensions, now appearing on the estimates for the first time:—Sir Theophilus Shepstone (late Administrator); P. J. van Staden (late Landdrost); Mrs. Hamilton (widow of Captain Hamilton); and Captain Beeton.

"*Colonial Defence.*—The apparent decrease in expenditure under this head, as compared with the actuals for the current year, is not real. The charges on account of colonial defence during the coming year will be far in excess of those which the Province has hitherto been called upon to meet. Under the head of 'Establishments,' it will be found that an outlay of £6,805 has been provided, on account of a force consisting of (73) seventy-three mounted men (officers included) and of (186) one hundred and eighty-six foot police. The amount shown under 'Colonial Defence' in the statement represents the cost of ration, equipment, &c., and the value of the contribution payable to the Imperial Government for the maintenance of the mounted infantry. The scheme for which provision was made on the estimates for 1880 was purely a tentative one.

"*Public Works.*—Under this head a sum of £9,810 appears on the estimates for 1880, of which only about one-half was expended up to September. I should state, however, that over £7,000 has been spent to date, and that the Surveyor-General reports work on hand on which a further outlay is involved of £2,500. In connection with these works, material of the value of about £500 has been used which does not show in the accounts. This sum represents the value of material prepared for building purposes by convicts.

"As it is a somewhat common complaint that, although the public are called upon to pay road-tax, the roads are rarely repaired, I would mention that the receipts from road-tax (current and arrear) during the three quarters of this year were but £627, whereas the expenditure on roads and bridges is expected to reach the sum of £1,400, of which £800 have already been spent.

"The necessity for public works on a large scale being undertaken is fully recognised; the current revenue could not, however, stand the additional strain which would be brought to bear on it by any extraordinary works being taken in hand. The reduction of the expenditure below the limit exhibited in these estimates does not seem feasible; special measures will therefore have to be taken to admit of works on a large scale being carried out. Whether it would be desirable to add to the burdens of the Province by borrowing capital for the construction of unproductive works is a matter which, I think, is open to question. It is certainly true that the annual rent for Government buildings in Pretoria alone represents a capital of £15,500, raised at 6 per cent. But I am afraid we should not obtain the accommodation we now have by expending that sum on new buildings.

"As regards the present debt of the Province, and judging by the charges annually payable on it, we find that in 1880 (1-7th) one-seventh of the revenue was devoted to meet the charges payable on account of interest, and in part liquidation of the principal. For 1881, the charge will be about (2-15ths) two-fifteenths of the estimated revenue, or about 2s. 7d. in the £; the fact must, however, be carefully borne in mind that the present debt is not a perpetual charge on the revenue, for, as will be seen from the statement which has been placed on the table, the principal is gradually becoming reduced. As an instance I would point out that of the two funded debts one (£63,000) should be extinct in 1893, and the other (£93,833) in 1902.

"Lest in making these remarks I be misunderstood, I would at once state that there is ample evidence of a marked financial improvement having set in, and I think we may depend upon even greater progress in the future. In support of this I would mention that whereas our overdraft, both at the Crown agents and at the Standard Bank, amounted on the 1st January to £163,496; at the present moment it is only £140,900. In reference to this improvement I notice in the leader of this morning's *Argus*, the following statement:—

"'But when it is considered that the process of squeezing has been very freely resorted to, the better balance-sheet shown by this Government can scarcely be regarded as representing the free and willing payment of taxes. In the majority of cases the debtors at all events wait until the demand has been made, and not a few refuse to pay until actually summoned before the Law Courts.'

n regard to this, I am happy to be in a position that our balances have not been materially by the action of the Courts. In September quested the Landdrosts to report what por- the revenue received by them had been paid issue of notices, how much after summonses, much through subsequent legal proceedings een taken. From their replies I find that a m than £18,200 was paid on intimation of the lue being received by the parties, £1,500 on es being issued, and £500 only on subsequent the Lower Courts.
. this it may be inferred the 'process of squeezing has been applied, perhaps, more in revenue officials than to revenue defaulters. Had the revenue officers been passed to do their duty, or had they been accorded greater facilities in the performance of it, in years gone by, it would not have fallen to the lot of this Government to collect the arrear taxes due to the late Republic. That there are many who adopt the *rôle* mentioned in the *Argus* is unfortunately a fact, but the present balances, as I have already stated, have not been materially affected by the attitude they have assumed, the conclusion to be drawn being that but for such action the improvement in the balances would have been even still more marked."

TRANSVAAL FINANCE.

OMPARATIVE STATEMENT PREPARED IN CONNECTION WITH THE FINANCIAL STATEMENT FOR 1880-81.

REVENUE.

HEADS OF SERVICE.	Actuals during whole of 1880.			Actuals for Three Quarters of 1880.			Estimates for the Full Year 1880.			Estimates for 1881.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
....	20,302	13	7	39,275	19	3	48,972	0	0	41,870	0	0
ative	596	10	0	13,225	10	0	35,000	0	0	40,000	0	0
Duties	19,252	19	8	17,791	18	9	18,270	0	0	22,120	0	0
ther than Import	35,399	14	0	40,130	4	11	34,833	0	0	49,550	0	0
....	5,732	14	4	5,094	15	10	6,000	0	0	7,000	0	0
eceipts	7,501	19	0	10,834	1	7	6,463	0	0	9,252	0	0
Receipts................................	4,622	5	11	7,041	16	6	10,120	0	0	2,508	0	0
Total	93,408	16	6	133,394	6	10	*159,658	0	0	172,300	0	0

EXPENDITURE.

HEADS OF SERVICE.	Actuals during whole of 1879.			Actuals for Three Quarters of 1879.			Estimates for the Full Year 1880.			Estimates for 1881.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
hments	36,499	0	9	28,394	2	4	49,299	10	0	63,735	10	0
s and Grants................................	1,673	11	11	1,066	8	6	1,430	0	0	2,150	0	0
l Defence	2,272	4	6	11,961	6	8	16,196	5	4	11,862	9	6
works	5,009	19	5	4,116	4	2	9,810	0	0	8,318	0	0
ance of Mails	13,395	6	5	7,695	2	11	12,200	0	0	11,461	10	0
nes	3,518	16	11	5,223	19	7	5,298	0	0	3,595	0	0
l	4,654	19	5	5,005	15	1	7,290	0	0	9,078	0	0
'ayments................................	31,342	9	5	27,751	8	3	35,778	2	0	39,010	12	0
Payments	19,388	5	6	4,760	5	5	6,050	0	0	5,700	0	0
nent of Loans	17,059	6	2	7,159	9	4	7,400	0	0	7,333	0	0
cks and Refunds................................	817	17	9	1,950	12	1	....			2,000	0	0
ph Construction	41,961	19	7	3,489	10	1	3,000	0	0	....		
Total	177,595	17	9	108,574	4	5	153,751	17	4	164,234	1	6

* To date our receipts have reached the sum of £171,300.

APPENDIX C.

E OF CAPE, NATAL, AND ORANGE FREE STATE.

'ollowing brief statement of facts will illustrate wth of the Cape Colony during the past sixty –

GROWTH OF CAPE COLONY.

—Area, 128,000 square miles; population—18,000; Hottentots, 29,000; slaves or apprentices, total population, 110,000.

—Imports, 454,166; exports, £150,900; includ-e, £82,170; public revenue, £109,000; public iture, £63,000.

—Total population of eastern districts only,

1830 to 1834.—Imports (in eastern districts only), £134,119; exports, £207,282.

1845 to 1849.—Imports (in eastern districts only), £1,356,000; exports, £1,017,391.

1850.—Total population of eastern districts only, 170,000.

1856.—Imports, £1,588,000; exports, £1,327,000 (exclusive of diamonds); public revenue, £348,000.

1865.—Population, 496,300.

1866.—Exports, £2,590,000 (exclusive of diamonds); public revenue, £732,000.

1875.—Population, 720,900, composed as follows:—Europeans, 236,783; Kaffirs and Bushmen, 314,133; Hottentots, 98,561; mixed races, 87,184; Fingoes, 73,506; Malays, 10,817; total, 720,984.

1876.—Exports, £4,499,000 (exclusive of diamonds); public revenue, £1,864,000.

Principal Imports at Durban from Official Returns.—Colonial Government Valuations.

Description.	1869.	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	Nine Months of 1880.
	£	£	£	£	£	£	£	£	£	£	£	£
1. Cotton Manufactures	46,626	51,852	61,977	102,377	86,824	85,246	98,275	58,548	56,910	103,035	131,245	82,140
2. Do. Blankets and Sheets	17,561	13,968	7,561	20,042	39,135	24,614	22,592	17,370	12,857	27,523	28,579	23,038
3. Linen Manufactures	3,710	3,173	7,949	20,183	10,476	9,128	12,090	8,920	4,299	12,793	25,940	10,764
4. Woollen Manufactures	11,415	12,048	12,403	22,447	23,872	15,520	19,961	9,632	13,418	16,368	19,972	17,305
5. Woollen Blankets	14,641	12,169	6,329	18,842	39,163	33,785	27,635	38,481	16,682	37,111	61,902	92,408
6. Leather Manufactures	14,632	15,603	21,708	33,577	40,188	51,057	70,854	55,315	38,106	67,136	99,038	85,242
7. Apparel, &c.	25,405	36,147	36,620	64,656	78,547	93,915	109,613	94,585	83,078	154,854	240,381	169,823
8. Haberdashery	36,494	42,348	50,361	77,546	96,286	101,381	134,040	73,935	80,604	136,546	186,025	150,350
9. Beads	..	..	..	..	..	..	..	..	..	5,026	2,995	5,296
10. Stationery	5,184	5,289	7,368	8,159	10,376	10,422	14,058	13,668	14,164	22,079	23,186	22,046
11. Guns and Pistols	5,604	7,511	8,703	20,156	38,430	28,316	24,121	10,684	4,825	8,775	7,207	3,549
12. Gunpowder	3,049	7,911	1,634	4,563	10,335	15,140	847	1,321	3,875	3,614	3,418	1,281
13. Saddlery	1,970	3,710	7,416	14,776	27,150	25,220	25,567	15,073	14,105	29,116	52,489	44,205
14. Cabinet and Upholstery Ware	3,663	4,267	2,597	8,866	21,797	16,446	19,534	17,322	20,583	26,473	29,785	31,789
15. Agricultural Implements	2,323	2,191	3,516	4,224	14,523	11,716	4,959	9,069	13,517	13,503	11,320	18,142
16. Machinery	10,727	15,204	13,762	18,363	32,410	25,124	31,335	35,671	34,800	26,045	21,665	26,304
17. Iron of all kinds	8,477	10,216	12,270	26,876	18,257	30,410	56,439	38,622	34,936	60,882	40,370	42,963
18. Ironmongery, Cutlery, &c.	14,862	21,118	27,564	48,557	71,551	85,893	86,062	30,225	54,625	76,685	97,746	54,848
19. Ale and Beer	11,464	8,957	11,650	17,595	19,961	20,514	23,868	26,208	28,905	57,736	60,298	70,750
20. Spirits	6,460	7,277	8,411	19,073	15,722	29,008	27,401	24,064	38,261	45,352	72,472	80,526
21. Wine	4,946	5,753	7,085	14,587	14,996	17,356	16,722	11,735	18,222	21,335	40,779	31,965
22. Coffee	9,991	11,817	2,597	3,666	3,167	9,662	34,118	22,258	42,284	84,976	36,739	32,874
23. Tea	5,820	5,266	5,536	9,791	8,261	7,203	10,474	10,863	9,315	24,288	18,612	5,490
24. Sugar, Raw and Refined	751	828	737	825	1,123	1,464	1,138	883	759	1,353	3,601	1,596
25. Oilmen's Stores	3,968	3,692	5,931	14,477	8,101	17,909	18,142	12,746	19,684	28,491	52,540	25,657
26. Tobacco and Cigars	1,532	1,432	2,082	4,438	5,604	5,326	6,608	6,813	6,136	9,045	25,244	13,124
27. Flour and Meal	15,414	12,364	18,816	17,053	23,027	38,099	33,243	30,969	53,164	96,191	85,176	42,145
28. Grain of all kinds	2,574	427	1,728	3,256	4,431	4,508	13,252	4,208	5,236	8,035	33,659	1,953
29. Rice	9,509	7,747	7,285	19,871	10,781	23,376	20,739	18,368	24,998	38,183	58,050	12,298
30. Others	..	..	..	..	..	..	..	..	..	..	605,923*	450,361
Total Value of ALL Articles Imported	380,331	429,527	472,444	825,252	1,011,465	1,121,948	1,268,838	1,022,896	1,167,402	1,719,562	2,176,356	1,650,232
Abstract. Imports.												
Clothing, Nos. 1 to 9	170,284	187,308	204,908	359,670	414,491	414,646	495,060	356,786	305,954	555,366	793,082	631,070
Food, Nos. 19 to 28	72,429	65,560	71,858	124,632	115,174	174,425	205,755	169,115	246,864	414,985	487,170	320,378
Customs Import Duties Government Revenue	39,702	45,571	46,726	81,913	96,003	109,724	114,769	97,108	106,286	162,947	228,510	183,215

PRINCIPAL EXPORTS BY SEA FROM OFFICIAL RETURNS.—COLONIAL GOVERNMENT (CUSTOMS) VALUATIONS.

(From Dr. Mann.—Prepared by Hon. F. Drummond.)

DESCRIPTION.	1869.	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1st Jan. to 30th Sept., 9 months of 1880.
1.—Arrowroot	£4,684	£4,696	£3,858	£5,647	£1,485	£2,220	£2,327	£3,806	£4,559	£6,841	£3,607	£1,489
2.—Grain	2,328	1,219	5,022	853	845	1,248	716	2,185	2,037	14,886	821	4,669
3.—Butter	8,408	7,298	4,719	5,178	4,509	963	2,019	689	821	1,724	...	...
4.—Hides	20,788	23,867	32,663	41,124	50,117	82,473	100,788	41,322	34,821	31,783	34,873	37,389
5.—Skins	24,915	45,275	63,975	91,469	85,809	70,688	45,942	13,252	7,919	5,406	2,509	2,339
6.—Ivory	10,449	12,051	12,140	9,022	17,168	8,580	8,289	11,006	15,014	12,044	8,678	5,025
7.—Ostrich Feathers	4,757	6,364	6,910	9,745	5,940	3,138	4,057	2,572	1,354	4,499	9,410	6,643
8.—Salt Meat, Bacon, and Hams	9,159	5,715	3,076	1,180	1,078	100	...	...	...	...	...	...
9.—Fruit	...	...	...	...	...	...	...	...	270	824	300	305
10.—Coffee	5,011	7,512	5,675	8,516	3,507	3,348	1,586	778	112	160	23	16
11.—Rum	1,364	2,051	2,182	1,227	736	1,391	4,259	3,059	2,243	644	23	500
12.—Cotton	2,301	3,479	5,763	5,400	4,379	1,165	203	89	...	...	...	...
13.—Cayenne Pepper	...	...	...	...	...	...	...	...	983	1,417	445	368
14.—Sugar	145,711	111,023	180,496	153,855	161,840	159,079	169,815	135,259	185,130	141,407	56,956	140,895
[Weight	7,477 tons	5,828 tons	8,741 tons	7,096 tons	7,065 tons	6,833 tons	7,775 tons	7,577 tons	9,194 tons	7,516 tons	3,010 tons	7,309 tons
15.—Wool	105,544	120,778	172,806	254,495	253,170	338,936	389,257	366,219	383,019	429,657	415,890	443,821
[Weight	3,350,437 lbs	3,612,501 lbs	5,763,939 lbs	5,654,416 lbs	6,309,573 lbs	7,888,794 lbs	8,108,397 lbs	8,548,611 lbs	10,012,356 lbs	12,077,966 lbs	12,029,216 lbs	12,840,629 lbs
16.—Angora Hair	...	...	...	...	...	...	...	1,468	4,519	6,487	4,897	9,743
Total Colonial	...	...	...	...	...	...	...	...	...	...	...	654,458
Not Colonial	...	...	...	...	...	...	...	...	...	...	43,670	31,212
TOTAL EXPORTS (above and other articles)	363,262	382,979	562,109	622,797	651,028	769,988	835,643	657,390	689,817	694,192	583,711	685,670

ABSTRACT OF NATAL TRADE FOR TWENTY YEARS, 1859 TO 1878.

BY SEA AT DURBAN.	TEN YEARS, 1859—1868.	FIVE YEARS, 1869—1873.	FIVE YEARS, 1874—1878.	TEN YEARS, 1869—1878.	ONE YEAR, 1878.	1879.	NINE MONTHS, 1880.
Imports	£3,777,604	£3,119,019	£6,300,646	£9,419,665	£1,719,562	£2,176,356	£1,650,232
Exports	1,786,656	2,582,175	3,647,076	6,229,251	694,192	583,711	685,670
Imports and Exports	£5,564,260	£5,701,194	£9,947,722	£15,648,916	£2,413,754	£2,760,067	£2,335,902
Customs Duties	£375,609	£309,915	£701,789	£1,011,704	£162,947	£228,510	£183,215
Clothing, Imports	£1,279,573	£1,336,681	£2,127,812	£3,464,493	£555,366	£793,082	£631,070
Food, Imports	£936,302	£449,653	£1.211,144	£1,660,797	£414,985	£487,170	£320,378
Sugar, Exports	£503,996	£757,925	£790,690	£1,543,615	£141,417	£56,956	£140,895
„ Weight	23,753 tons.	35,708 tons.	38,905 tons.	74,613 tons.	7,516 tons.	3,010 tons.	7,309 tons.
Wool, Exports	£544,154	£906,794	£1,908,088	£2,814,882	£429,657	£415,890	£443,821
„ Weight	12,935,648 lbs.	24,690,926 lbs.	46,636,124 lbs.	71,327,050 lbs.	12,077,966 lbs.	12,029,216 lbs.	12,840,629 lbs.
Sugar and Wool	£1,048,150	£1,659,719	£2,698,778	£4,358,497	£571,064	£472,846	£584,716
Actual Government Revenue	£1,008,780	£751,044	£1,414,939	£2,165,983	£369,384	£473,478	
„ „ Expenditure	£1,071,296	£650,330	£1,494,252	£2,144,582	£387,067	£490,825	

1820.—Currency, depreciated paper; churches out of Cape Town, 3; education, much neglected; *Government Gazette*, and an advertising sheet, only periodicals publications.

1824.—Press statistics—7th January, Messrs J. Fairbairn and Thomas Pringle (*The Post*), published in Cape Town, the first number of the *South African Commercial Advertiser*; May 17th, publication interdicted by Lord Charles Somerset.

1827-8.—Royal Commission sent out in 1824, recommended in Report, dated 6th September, 1826; freedom of Press; establishment of Supreme Court, under Royal Charter of Justice; substitution of Civil Commissioners, Resident Magistrates, and Justices of the Peace, for Boards of Landdrost and Heunraden; abolition of "Pacht" (Government monopoly of sale of wines and spirits) of office of Vendu-Master (Government Auctioneer), and Burgher Senate.

1829 to 1839.—South African College founded in 1829. Sir J. Herschel arrived 16th January, 1834, and submitted an education scheme to Government in 1839. Dr. Innes, first Superintendent General of Education. 20th May, 1835, King William's Town founded. Abolition of slavery, proclaimed in 1834, came into effect at the end of four years' apprenticeship, in 1838. 1836—Six thousand Dutch colonists followed Field Cornet Piet Retief, when he "trekked" from the colony.

1840 to 1850.—Road-making commenced by Mr. John Montagu, Colonial Secretary. Public road Board, established 1844. Territory of Natal annexed to Cape of Good Hope, 31st March, 1844. 29th July, 1848, Battle of Boomplaats, declaration of British Sovereignty over Orange Free State, and consequent founding of Transvaal republic by defeated emigrant Boers.

1851 to 1861.—1853, 21st April—Orders in Council granting representative constitution. First Parliament, 1854. Orange Free State made independent, 1854. First sod of Wellington Railway turned by Sir George Grey, 31st March, 1859. Railway finished, 1863. First truckful of stone for Cape Town breakwater tilted by H.R.H. the Duke of Edinburgh, 17th September, 1860. First stone of docks laid by H.R.H., 25th August, 1867. First line of electric telegraph completed to Simon's Farm, 1860. Public library and museum founded by Sir George Grey.

1862 to 1879.—First diamond discovered, 1867. Responsible Government established, 1872. University of Cape of Good Hope incorporated, 1873. Griqualand West annexed, 1877-80. Submarine cable, 1880.

1865.—Education—Schools, 360; scholars, 30,335; State expenditure, £23,027; local expenditure, £19,396; area of holdings in Colony (morgen of two acres each), 20,464,000; area of land under cultivation (morgen), 217,692; wool produced, 18,905,000 lbs.; mohair, no return; live stock (woolled sheep), 8,370,000; draught cattle, 249,000; other cattle, 443,000.

1875.—Education—Schools, 641; scholars, 54,157; State expenditure, £38,753; local expenditure, £43,595; area of holding in Colony (in morgen—two acres), 39,947,000; area of land under cultivation (in morgen), 274,413; wool produced, 28,316,000 lbs.; mohair, 128,128 lbs.; live stock (woolled sheep), 9,986,000; draught cattle, 421,000; other cattle, 689,000.

1879.—Education—Schools, 843; scholars, 66,000; State expenditure, £70,000; local expenditure, £81,000.

The following statistics of three districts in the Orange Free State, are taken from the *Cape Times*, of the 10th November last:—

"The *Friend of the Free State* gives the following statistics:—'The total population of the district of Bloemfontein. Winburg, and Cronstadt is, respectively, 13,274, 15,858, and 14,177—the first named district, however, possessing the largest number of white inhabitants. The number of woolled sheep in the said three districts is, respectively, 640,031, 582,390, and 478,160. The entire area of the district of Bloemfontein is 1,139,165 morgen, of which 1,894 are cu Winburg, 1,337,340, of which 3,878 are cu and Cronstadt, 1,522,300, of which 6,649 are cu Cronstadt is consequently the largest distric three, and Bloemfontein the smallest. Bloe possesses the most horses and woollen sheep, Wi most horned cattle and big-tailed sheep, and C eclipses the other two districts in the number o annually produces.'"

APPENDIX D.

Diamond Cutting in Clerkenwell.

In connection with the industries that are m affected by the discovery and importation diamonds, the recently established lapidary Messrs. W. Ford and Co., of Clerkenwell, d notice. A full and detailed account of their e ment appeared lately in the "Watchmaker, and Silversmiths' Trade Journal."

About a century and a half back, London chief seat of the diamond-cutting busines cumstances caused this industry to be rem Amsterdam, and this city till very lately monopoly of this trade. To the untiring e Mr. W. Ford is due the revival of this ind England. About seven or eight years ago he lapidary in Red Lion-street, first turned his att the cutting and polishing of diamonds. Gre verance was necessary, because people natura tated to entrust valuable crystals to the least cl unskilled handling. This prejudice was, gradually overcome, as Mr. Ford's skill was we show that the diamond cutter's art was not in possession of the Dutch. Although at firs dependent on Dutch workmen, they are now s seded by Englishmen, to the great satisfacti firm. It is to be regretted that some of the cutters emulate the jealousy of their Dutch and try to keep their experiences to th Such is, however, the case; so that Mr. F obliged to separate men and apprentices, take the latter under his own supervision. in 1874, some of Mr. Ford's *employés* carried o prizes offered by the Turners' Company daries' work. Mr. Vincent Albertoldi secu prize for his remarkable fine shell and carbuncle, and Mr. Henry Giles Spencer th for carved onyx shell, bow and flower of grea Their exhibits were bought by Mr. Hunt and Tennant, two of the judges for the lapidary mark gratifying alike to the artists and their e In class D (diamonds), Mr. John Parsons and Watts, also employed in this factory, took se third prizes respectively. In 1876, Mr. Charle ton, Mr. George Brown, and Mr. Thomas Jo again successful competitors for prizes offere same company, all *employés* of this establishme

Extract from the "South African" for Nov.

The Diamond Fields of Griqualand W R. W. Murray.

The South African Diamond Fields are on greatest, if not the greatest, wonders of mode The discovery of diamonds on the banks of River, in 1868 and 1869, attracted thousands of to that part of Griqualand West, and to the e ment in 1870 of the Hebron, Pniel, and Bar gings, and afterwards to such other river dig Waldek's Plant, Cawood's Hope, &c., &c. Up the end of 1870 it had been concluded that deposits were only to be looked for on the bank

* A paper by Mr. T. W. Tobin, "Notes from a Diar through South Africa," is published in the *Journal*, p. 351.

ut before 1870 had closed, it became known that ds had been found at Du Toits' Pan without g out the diamondiferous soil, which was, during ly time of the river diggings, a most laborious on. The river diggings was then almost aban- and diamond-searching was carried on for a long t Du Toits' Pan on the dry-sorting system.

the year 1871, it was ascertained that there were ds in the Kopjes of Old de Beers and Bultfontein, July of that year the Colesberg Kopje (now the ley Mine) was rushed, and the whole of the four mentioned diggings were for a long time worked dry sorting system, and the *débris* thrown to- in heaps outside the diggings and abandoned. , however, the diggers found that the abandoned ontained almost as many diamonds as they had ut of the diamondiferous soil whilst it was in nds, and that it would be ruinous to continue y-sorting system, as one-half of the diamonds be lost to them, unless the soil, when taken out of ims was thoroughly saturated and washed out ater, as they had been accustomed to wash it out ligging on the river banks. When the Kimberley and the Vooruitzigt estate, on which the Kim- Mine is situated, were purchased from Messrs. and Co., the proprietors, by the Government, 0 was offered for the abandoned *débris* surround- at mine alone, which offer was refused.

diggers having ascertained that water was the essential to successful diamond-searching, and the ter of working claims having changed, at least ars since, from diamond-digging to mining for ds, new and more effective appliances than the used at the river were invented, and wells were It was also ascertained, when the light surface as passed, that the richer diamondiferous strata f a rocky nature, and that this must be thoroughly ted with water, and exposed to the sun, before it be sufficiently crumbled for washing out in the machine; and, from the time that strata has been amond-yielding material, the demand for water en immense, and far greater than the supply.

the last six years, at Kimberley, Old de Beers, oits' Pan, and Bultfontein, diamond-mining has a permanently settled industry, as is coal-mining ewcastle, copper-mining in Cornwall, or tin- g in Devon. It was estimated long since that was invested in claims, plant, and steam nery, in the beforementioned four mining centres, welve millions sterling (£12,000,000), and Messrs. r, Ransome, and Sims, and other engine and ine manufacturers, are sending out first-class es and machinery by mail steamers, and are never ut orders in course of execution. There are no ments so much sought after as those which the nd-fields offer, and the value of claims has sed more during the last year than in any other f the existence of the diamond-fields.

claimholders consider that when the Kimberley r Company shall have made the water supply ent and regular, their returns will be so much r as to greatly add to the value of their claim rties, which they, since the last Act of the Griqua- West Legislature, hold on fixed property titles, d of on monthly license as heretofore.

no season does the present water supply approach mand for mining operations and town consump- The rainfalls are confined to but a few months of ar only, and, subject as the country is to periodical hts (which, during the ten years of the diamond have covered half the period of their existence), lls dry up, and mining operations are occasionally ht to a standstill.

n the Vaal River only can a sufficient supply of for miners and householders be obtained. Water e had by the miners at whatever price is demanded ll proprietors, as the suspension of mining opera- tions is utter ruin. The claimholders, by such suspen- sion, would lose all their native labour, and when once the natives are thrown out of employ, they leave for their homes, many of which are from 1,000 to 1,200 miles distant. The costly establishments must be kept up, license money must be paid to Government, and rates to the mining boards, whether the claims are worked or not, and all this in addition to the loss on dormant capital invested, which is very great, seeing that many of the claims of 30 feet by 30 are of the value of from £5,000 to £10,000 each.

Water has for years never been obtainable for less than 2s. 6d. for about 100 gallons, and in times of drought it averages 5s.

Since the establishment of the mines, fine, large, permanently settled towns have grown round the mining centres, churches of all denominations, with accommodation equal to those in the older towns, have been built, and others are in course of building. The Customs' duties paid on imported articles of consump- tion in the fields has been estimated by the Secretary of State for the Colonies to be at least one-third of the whole amount received at the colonial ports; over one million and a-half is paid for land carriage from the port towns to the fields; the trade done in Kimberley, Du Toits' Pan, Old de Beers, and Bultfontein is larger and more brisk than in any towns of the same size in South Africa, and four banks have been established, and they do a very large and lucrative business.

During the last seven years the mines have afforded employment to 650,000 natives, at an average wage, in money and kind, of 22s. per week. There are never less than 16,000 natives at work in the mines in addition to white labour, and the annual municipal revenue administered by the Town Council, chiefly obtainable by a rate of 3d. in the £ on the value of house pro- perty, is upwards of £25,000.

That the diamond mines are destined to be perma- nently the greatest wealth-producing power of the country, has been ascertained by experiments of various kinds; and the shafting which has taken place proves that depth does not abate the yield of diamonds; and that the deeper the digging the better the quality, as those who have had experience in the Kimberley and other mines can affirm. The building trade flourishes more and more every year, as stores and residences are now built of brick and stone, and the great proportion of merchants, traders, and mechanics have made their homes, and settled down with their families, in the towns.

Sir Bartle Frere, at a banquet given in his honour at Kimberley this year, in speaking of the great progress, wealth, and importance of that place, said:—"Even if diamonds failed to-morrow, which they certainly will not do, Kimberley will always be a large, wealthy, and important town, it being the centre of the great interior trade of South Africa."

Since that time the London and South African Explo- ration Company have laid out a new town of great size on the Kimberley side of Du Toits' Pan, and not only has every building site been taken up, but already handsome stores and residences of brick and stone are in course of erection there, whilst Bultfontein has extended itself up to the boundaries of Du Toits' Pan.

The diamond fields are now part and parcel of the Cape Colony, which as the returns of the Crown agents show, is one of the wealthiest and most progressive of all her Majesty's colonial dependencies, and the 4½ per cent. debentures recently issued for the annexation of Griqualand West to the Colony were placed at £102 to £103.

London, Nov., 1880.

APPENDIX E.

OSTRICH FARMING.

The following sound remarks on ostrich farming are from a late number of the "Squire:"—

"I don't think ostrich farming may be fairly said to date further back than the year 1865. I know that when I arrived in the colony, in 1863, such a thing was unheard of, indeed it was not until 1870-1-2 that any appreciable advance was made.

"The ostrich (*struthio camelus*), as Macaulay's "every schoolboy knows," is a bird of the desert, its habitat the boundless, mirage-distorted, sun-scorched, dreary Karoo. So extensive are his feeding grounds and rapid his movements that fifty or sixty miles are often travelled by him, in a wild state, between daybreak and dark.

"How, then, were the subjugation and domestication of this lord of the desert achieved? For the most part by securing the chickens when very young, or else by procuring the eggs, and hatching by artificial incubation, so that in a very few years in the place of tens as many thousands might be counted in both provinces, east and west. Indeed, so rapidly did they increase, that great fears were entertained by many that over-production, and consequent depreciation in value, would be the ruinous issue. But this was not to be. Nature in this, as in many other instances, apparently demands a penalty for domestication. Her laws being violated, and made subordinate to artificial methods, produced diseases of various kinds. I have known instances of whole broods dying off suddenly, without any apparent cause, in spite of every care, attention, and treatment. Numbers die from exposure to cold and wet—from broken legs, intestinal entozoa, stoppages in the intestines, diseased liver, and various other causes. If not in a sound, healthy state, a cold rain is almost sure to prove fatal. As an instance, I once had a flock of nine-months-old birds exposed to a rain of two days' duration. They got so thoroughly saturated, exhausted, and chilled, that they could not be brought home to a place of shelter. Even after the weather had cleared up, one of the poorest-conditioned was so completely numbed that he could not be induced to walk a step, and had to be carried home in front of a man on horseback, wrapped in a wool bag. In this plight, almost lifeless, he was placed before a brisk fire, and a pint of warm gruel, with about half a tumbler of brandy, was administered to him. This, repeated at intervals of about twelve hours, entirely restored him, and I had the satisfaction of selling him some few months after for £25.

"A man to start ostrich farming fairly should have at least £1,500 capital. He would, in the first place, have to hire a good farm, say of 4,000 acres. This seems at first sight, especially to an inexperienced person, unnecessarily large. In good seasons, of course, it would be, but then one must reserve for times of drought and scarcity. For this farm, unenclosed—there being very few enclosed farms in the colony—he would have to pay a rental of about £150 per annum. To stock it he would require to purchase at least 100 young birds, at say £10 a piece—total £1,000. For £400 he could purchase three pairs of good breeding birds. These he would have to put in separate enclosures, or paddocks, of say ten acres in extent. Wire would be the cheapest fencing, drawn very taut, and wattled through from top to bottom with bush, as birds are liable to kick through and hook their legs fast, and often break them. And here let me add, a broken legged bird never recovers. The best and most humane way is to knock the ostrich on the head at once. You may bind and splinter the broken bone, but it doesn't help. He kicks, and struggles, and worries in his efforts to rise, that it makes the healing or uniting of the broken member a matter of impossibility. It is not unusual for birds, when playing or waltzing—which they do in the most graceful manner, whirling round on tip-toe with expanded wings—to drop down as if shot. You go up surprised to see what is the matter, and find a broken leg, snapped like a carrot.

"To return to the question of expenditure. We have supposed it to cost about £1,400 to stock the farm with birds. We have still £100 remaining. This would be required for purchasing wire, poles, implemen[t] &c. The first year's increase of three pairs c[...] ing birds would be about two broods each, of s[...] a brood. This is a low calculation. I have [...] pair to bring out as many as four broods in o[...] but they were exceptionally good. Thus fr[...] pairs he would get sixty chickens. Their val[...] average about £10 each, so we have here [...] chickens alone. The first crop of feathers fro[...] ing birds, at an average of £1 per bird, would g[...] Total of first year's produce £700. Plucking [...] two years and upwards yielded, when I left th[...] in April last, an average of about £8 per bi[...] feathers are plucked, or rather cut, three time[...] years or once every eight months. This is a [...] ple process. The birds are driven into a small e[...] or yard, and packed so closely as not to adm[...] room for shifting about. Then you take a cli[...] the feathers with one hand, and cut with t[...] The blacks, drabs, and tail feathers are always [...] only the wing feathers are cut. In two mon[...] the points or stumps are drawn; they, being t[...] and ripe, come out with ease.

"The ostrich feather is characterised by h[...] quill exactly in the centre of the feather, [...] other birds it is a little on one side, causing t[...] on each side to be of unequal width. The ele[...] the feathers, arising doubtless from their be[...] tapering shafts and delicate gossamer webs, [...] to their being valued highly as articles of orn[...] all ages. The Egyptians are supposed to have [...] them as a symbol of justice, from the fact of t[...] of the webs being equally balanced on each [...] the shaft. In old paintings of Rembra[...] Vandyke, ostrich feathers hold a prominent [...] as ornaments in the hats of the bucks and bloo[...] time.

"Ladies do not seem to have taken to them [...] comparatively modern date. Now they have b[...] fashionable, that the deep-seated harassing dre[...] bosom of the ostrich farmer is that they wil[...] too common, and therefore be disused by th[...] classes. But I think there is little fear of this, [...] first-rate feathers will always maintain a pric[...] ently high to preclude the possibility of thei[...] into general use.

"A very important *desideratum* is the obtain[...] good farm. Some farms are almost entirely [...] for ostrich farming, being destitute of ver[...] requisites, such as salt bushes (*brak*), succulen[...] &c. An inexperienced person must on no [...] trust to his own judgment, or his ve[...] almost sure to end in disappointment and l[...] he has no friends in the colony, he should ol[...] troductions, either at Cape Town or Port Eliz[...] some well-known breeder of respectability and [...] In a future article I shall endeavour to give [...] count of the habits and ways of the ostri[...] domestication, and on the method of hatching, [...] and rearing the young.—Alfred Evans."*

Vine Culture.

The cultivation of vineyards was one of th[...] industries established by Europeans in Sout[h] the Dutch settlers soon found the climate a[...] their new home favourable for the growth of [...] almost every settler had a patch of vines attac[...] holding. But the more general and better treat[...] derived from the French emigrants, who at o[...] themselves down to this special cultivation; [...] however, the eminently conservative habits of [...] overcame the greater enthusiasm of their Fre[...] bours; at all events, certain habits were acqu[...]

* A paper on the "Progress and Prospects of Ostri[...] in the Cape Colony," by Mr. P. L. Simmonds, in p[...] Society's *Journal*, vol. xxiv., p. 228.

ced, and a treatment of vineyards was followed, ich because it was good and suitable, as because e custom. This has continued pretty much, but rare exceptions, to the present day, and a ourse is generally adopted irrespective of the of species, of soil, of aspect, of drainage, or ther essential factor. Wines thus produced a certain fixed character, and it is not so it the European cultivator has advanced, as Cape farmer has stood still, that has operated improvement in the character of Cape wines. re, however, been other evil influences at work. ir merchants adopted the practice of giving a ced price for wines each season, and the man the least trouble, and by any means, produced got the same price as one who had expended care. Thus, the only consideration soon be- ntity. Farmers took to planting their vines he valleys, and, not content with the natural and swamps, actually, in many cases, led water rough their vineyards; the result need not be ed on. The wine merchants having, as thus d the price of wine at the beginning of the ought from anyone as far as their means per- nd emptied all their purchases into large, what d, "stuckvats," holding from 800 to 1.000 Before this, however, the farmer had supplied ral fermentation by large admixture of spirit, ly made, and from which there had been no of extracting the fusil oil. The wine now on ds of the wine merchant was mercilessly h, more spirit and compounds were introduced, raw wines delivered in April, May, and June ficiently "prepared" by the wine merchant to be d matured wines by about November and Decem- what result as to quality need hardly be said. a great encouragement to the manufacture of s arose from the protective Customs duties in , all foreign wines paying 5s. 6d. per gallon, ial made wines only 2s. 9d.; thus, while this n lasted, the differential duty admitted a very portation of Cape wines, the quality of which d to depreciate. No wonder that Cape wines, ch influences, acquired a bad reputation. On ration of the English wine duties, the Cape lapsed, and from that time the exports hence n quite insignificant, and are almost confined to ive wines, which, from their excessive sweet- rather liqueurs than wines. About three years ery energetic attempt was made to improve the of Cape wines; some few gentlemen were im- ith the importance of rallying the most im- industry in the western province, and from owledge of European viticulture, were per- hat, with a most beautiful climate, a fertile good vines, only science was necessary to good wines. After very great labour and diffi- y started a company called the South African owers' Association. Shares in this company legrees taken up, and the first act of the then Board was to get out an expert from Europe ly acquainted with wine growing and wine This gentleman was at first coldly received rmers, wedded to their old prejudices; but, as s they realised the fact that the company would s by quality, and pay an excess over anyone wines made on their system, the number of aking wine on the improved principle increased, yet very far from general. The expectations omoters of this company are fully realised by y of their wines, which, of course, are as yet years old, but they show a promise of quality nknown, and such as must command a large trade, but for the present, the home demand, lonial, is probably as much as they can supply. sets of the company are in every way excellent. oo much to say that the company promises to be one of the most remunerative and important institutions in South Africa.

The chairman of the Wine Growers' Association (before referred to) having gone through a large part of the French and German vineyards about a year since, partly for the business of the company, was naturally much alarmed at the rapid spread of phylloxera, and made this disease a careful study. On his return to the Cape, he felt with others that it was essential steps should be taken to prevent, if possible, the introduction of this pest to the colony, and very strong representations and petitions were presented to the Government, the result being, that all vines, cuttings, grapes, plants, tubers, and bulbs, were forbidden to be imported; the Government further, on the prayer of the petitions appointed a Commission to ascertain if phylloxera existed in the colony (as had been stated) and further, to report on the diseases really incident to our vines and viticulture generally.

Specimens of vines said to be affected with phylloxera, contrary to the distinct opinion of the Commission, have been sent to England, and submitted to Sir Joseph Hooker and Dr. Corner; unfortunately, the specimens did not arrive in good order, but so far as the before-named gentlemen could discover there was no trace of phylloxera; fresh samples preserved in alcohol are going home immediately for further investigation, but it may safely be affirmed that the disease does not now exist in the colony.

The labour and researches of this Commission promise to be most important, not only showing what diseases now exist, but how the different soils should be treated. Hitherto, a sort of uniformity of plan has been adopted, whether the soil was stiff clay or light calcareous soil; in fact, with but very few exceptions, viticulture here may be said to be half a century behind its condition in Europe. Further, it is the design of the Commission to prepare maps, showing the area occupied in wine farms, the number of plants on each, the soil and the aspect, when on a hill, &c. When this is done, the colony will, for the first time, know the real extent of this industry, at present, calculating on the area already examined, there cannot be much less than 150 millions of vines in the colony, and but a fraction of the land well adapted for this business is yet under that cultivation. For miles, running along one of our main lines of rail from Cape Town, hills ascend on either side, and, probably, no climate or soil in the world is better fitted for the cultivation of vines, and it is no exaggeration to say that there is an area in the colony of the finest soil for vineyards, capable of supplying the whole world, if the devastations in Europe progress. Many people affect to sneer at the Cape wines; but, though it is undoubted they were bad, it is proved that they can be made excellent, and there can be no doubt that further scientific applications will show, as in Europe, continually improving results. It is at first sight somewhat surprising that European capital and talent has not more largely sought this country; but a wine farmer is not a very ready emigrant, time and capital are required, and comparatively few emigrants can afford to wait three to four years, which would be occupied in bringing a vineyard into good bearing. Already, however, pioneers from Europe are beginning to turn their attention to this industry, and provided only we can keep out the phylloxera, viticulture will form as important a source of wealth to this colony as it has proved in France.

APPENDIX F.

AGRICULTURE.

Memo of Information Furnished by Walter Peace, Esq., Emigration Agent for Natal, 21, Finsbury-circus.

Coffee.—Crop in 1870, 960 tons. Quality classed as "Plantation Ceylon," very good. Crop gradually

declined for years after 1870, and is now only again beginning to increase. Reason—Planters got an idea that continually pruning would "help nature;" they "bled the trees to death." Since the planters have allowed nature to do the work herself, the growing of coffee is beginning to pay again. Instead of using the knife, the planters manure the trees.

Sugar has a history in Natal similar to that of most other cane-growing countries. The beginners had neither the practical knowledge requisite, nor the necessary capital. Fifteen years ago Natal planters thought that only flat lands were suitable, now the bulk of the crop is grown on hill lands. The planting season is September to November. The first crop is ready about 21 months after being planted. The cotton crops follow at intervals of from 15 to 18 months; generally at least three crops are taken from the same plants. On some few rich alluvial flats, as many as 10 or 12 crops have been taken without the land being re-planted. First crops on good land, if with ordinary favourable season, and if the weeds be kept down, are calculated to give 2½ tons (5,600 lbs.) per acre, besides treacle, which is afterwards distilled into rum. Succeeding crops, called first rattons, or second rattons, are expected to yield not less than 1½ tons (3,360 lbs.). These figures are below the average experience of planters in good seasons, 3½ tons of sugar per acre for first "plant cane," having often been obtained. The terms of sale in Durban are prompt cash. The average value, taking the average by shipments, is between 22s. and 23s. per cwt. White crystal sugar realises 28s. to 30s. per cwt. Yellow crystallised, 24s. to 25s. per cwt. Heavy syrup sugar, 17s. to 18s. per cwt. The "Central Mill" system has been at length successfully introduced at the the "Usine Centrale" in Victoria county, where growers of cane deliver their crop (by rail or by wagon), and, after the juice is extracted, the value of sugar contained therein is ascertained by testing the density of the juice. The grower can receive his payment for the proportion coming to him (calculated at about two-thirds of the value of the sugar at existing prices) without delay, the manufacturing company making a profit on the cost of manufacture out of the other third. The mill I refer to has cost from about £70,000, I hear, and will turn out 15 to 20 tons of white crystallised sugar per day. A mill capable of making 2 tons of sugar per day can be erected for about from £5,000 to £6,000, including all good buildings. The present crushing season is said to give the largest crop yet produced in the colony, and is estimated at 15,000 tons—worth over £300,000. As with coffee, "the lane seems to have turned," so with sugar; the losses of the past, which have been very heavy, and from many causes, seem likely to be compensated for in the immediate future, not, though, in many instances, to those who suffered the loss, but to others who have purchased estates which the former owners could not retain. Manuring the land for sugar-cane has only been resorted to as yet in very few instances in Natal.

Extract from the "Natal Witness," October 9, 1880.

PIETERMARITZBURG AGRICULTURAL SOCIETY.

One special general meeting and five committee meetings have been held during the year, all of which have been well-attended. The subject of procuring the passing of a Fencing Law was under consideration at one of the above meetings, and a petition for the purpose was framed, after several discussions, and laid before the Legislative Council.

No legislation thereon has yet resulted, the subject being found to be surrounded with many difficulties.

The exhibits of live stock were, on the whole, satisfactory, all the pens erected for cattle, and most of *those for sheep,* being occupied by well-bred animals, many of which non-exhibitors were frequently heard coveting the possession of.

The pens of cows and heifers were far superi previous exhibits, and of bulls of various breeds were a number of entries, most of them sup animals.

Sheep at this show almost surpassed the cattle i gard to merit—the pens of newly-imported bouillet merino rams which were exhibited greatly admired for their size of carcase, lengt staple, and quality of fleece. Several fine-fl Negretti rams were also exhibited, as also some pe superior crossed Negretti lambs. In the class colonial merino ewes, cross-bred merinos, and An goats, the exhibits were good. Only two pens o wethers were shown from Boston district, by breeder, Mr. James Stewart. Usually the butchers compete for this prize.

Horses did not show up in numbers equal to previous years. Those exhibited were, however, wo of commendation. Only two imported sires were sh under Class 1, but of imported cart-stallions fou animals were paraded in the ring.

The exhibits of produce, poultry, dogs, &c., in the Market-house, fell far short of the display on past occasions, but the quality as well as the variet the exhibits in the produce and food classes were interesting and worthy of the several awards wh were made by the judges.

Wool, at present our principal exports from the lands, has turned out well during the year, both regard to yield and value, and sheep-farmers have gratified in receiving good prices for their clips. value of Natal grown wools, in the colony, during year, has ranged from 7½d. to 9½d. per lb. for gre and from 10½d. to 13½d. for washed fleeces—condi quality, and length of staple determining the val Large quantities of wool (yearly increasing) are shipped as scoured snow whites, some parcels of whi being of good staple and well got up, have realised London equal values with ordinary Uitenhage whites.

During the past year several importations of valu live stock have taken place in the way of entire horses, draught stallions, Rambouillet and Neg merino rams, and further arrivals are expected. these and former importations we may in due co reasonably hope for considerable improvements in flocks and herds. Several ostriches have also been in duced coastwise.

The erection of wire fencing continues to increasing headway in various directions, an large extent of land must have been thus encl since I last addressed you. Many, however, desiri enclose their lands, or to form paddocks, are preve doing so by the difficulty of procuring suitable for the purpose, or the needful timber for posts sufficiently reasonable price. As time goes on, fenci of lands will be adopted to a large extent.

One objection to wire fencing is its partial invisi and consequently the liability of stock getting enta therein.

One sign of substantial progress and economisi labour that has come under my notice during the is the successful application and use by Mr. G Richardson, of Faulklands, near Pietermaritzbu the steam plough, and of the harrows worked by same agency—200 acres having, I believe, been fully cultivated by the steam plough.

Agricultural prospects on the coast have very improved during the past year, rain having been frequent and evenly divided along the coast belt. the staple export product of the coast, is reported yielding a good return, while the growing crops well for next season. The crop of 1879 amount about 8,000 tons. This year's crop is calcula yield from 13,000 to 15,000 tons, at an averag

This gives £260,000 to £300,000 as the urns from sugar this year.

also turned out a better yield than for s past, although many coffee plantations lowed to die out, or have been cropped with drought and the borer insect played such hem. A few small plantations, or plots of coast, in Victoria County, also in other re under tea culture, with fair success. A resident at the Isipingo, informed me last with the exception of the last two or three had not purchased a single pound of imr his household during six years past, using what he had himself grown, which he of very good flavour. This shrub does in many localities in our uplands. Arrowe pepper, ginger, and other exportable luct still continue to be grown on the re exported to a small extent. The delay attendant on effecting sales and returns n, tend to retard an extended production. articles of limited consumption and defrequently to be held for months after arrival can be effected at anything like fair es.

grown in our midlands, but on the coast arger extent, fully supplying all local de- unmanufactured article.

ntinue to be grown to a large extent by he coast, these people requiring to dispose s as soon as possible after reaping, to enable rent and other demands. The value of this low until the Coolies have sold out. Some of coast-grown maize have lately been st-wise,--prices ranging from 7s. to 10s. 200 lbs., partially to supply a demand which exist at the Cape and Port Elizabeth—for of feeding ostriches—so long as we are able against imported maize. At present the alies on the coast has risen to 18s. and id. I believe some shipments of maize are cted from Europe to supply the demand. n on the coast during the last year or reased fully 50 per cent.—especially along he lines of the railway—which has greatly he sugar and other enterprises.

h pleased to learn, from several sources, er of sugar planters, who have been able nselves of the advantages offered by the l Sugar Mill ("The Usine Centrale") at ecombe, in crushing and manufacturing to sugar during the present season, have satisfied with the results in every case, both he quantity and quality of the sugars pro- that several planters have expressed their close their own mills next season, and crush crop at the above splendid mill, which is be capable of turning out 2,500 tons of gar in the season, to a value of, say,

ese gentlemen, though forced to send their ance of twelve or fourteen miles by rail Umgeni), nevertheless intend to repeat the Here, then, is a proof of what I have ced as my hope and opinion, that the hitherto surrounding the production of rsons of limited means is to be overcome ral Mill system—one party being employed more simple employment of growing, and the manufacture of the cane into sugar, enterprise made a profitable one to both, creasing the exports and wealth of the

referred to ostrich farming in my address 78, as then engaging a deal of attention in Province of the Cape Colony. In July avelling to Grahamstown, Graaf Reinet, and other places, I was much surprised, notwithstanding all I had previously heard regarding the prosecution of ostrich farming, at the extent to which the breeding of and dealing in ostriches had attained, and the large returns which are, in many instances, derived by the hatching and rearing, the purchase and re-sale of birds, and the crops of feathers which are plucked from them (according to the fancy of the owners) every six or nine months, as also at the large sales of feathers held on the market at Port Elizabeth, every week, on Mondays and Tuesdays, throughout the year. These sales average from £8,000 to £15,000 weekly, the first amount being considered rather a low return. The total value of feathers sold on this market alone (irrespective of sales inland, or in the Western Province, where ostriches are also bred), during the six months ended June 30th this year, totted up to £276,188 1s. 10d., and for the year 1879 the total sales were £391,129 11s. 8d. I think I may safely put down at least two-thirds of this sum as the returns from domesticated birds, the proportion of wild feathers being very small.

One gentleman, Mr. Distin, of Tafelberg-hall, Graaf Reinet district, has about 1,000 breeding birds and innumerable enclosures on his farm. He is supposed to realise at least £10,000 a year by ostriches.

The common prickly pear plant (*Opuntia vulgaris*), which, having spread itself over large tracts of country, had previously been considered a pest, and large sums spent by some landowners in attempts to eradicate it, is now found to be good green for ostriches. Stuck on a fork or stick, and run through a blazing fire to scorch the thorns, it is chopped up with or without lucern. Mealies and barley are also used to feed with.

I was informed that the first census taken of domesticated ostriches in the Cape Colony in 1863 was returned as 88 head. In 1875 the second census returned 22,000. The number is now believed to be quite 100,000. Companies are now being formed to prosecute ostrich farming.

Angora goats and ostriches have all but supplanted sheep in the Zwaart Ruggens and Graa Reinet districts, as being less liable to losses by droughty seasons. I lay before you two samples of Angora hair from a superior flock in the above district, from which flock I hope in a month or two to introduce six rams. This sample is taken from wethers, and is fully 12 inches in length, and of good lustre. This breeder's ordinary clip was sold at Port Elizabeth in July last at 2s. per pound. The market for this product is rather depressed just now.

APPENDIX G.

STEAMER LINES.—HULL TO BENGUELA.

Extract from a letter from Mr. A. K. Rollins, secretary to the Hull Literary Society, dated Cogan-house, Hull, 8th December, 1880:—

"The steamers to which I referred are those of Messrs. Bailey and Leetham, of this port, and of Lisbon. They write me as follows:—'In reply to your note of yesterday, our African steamers leave Lisbon and touch at the undermentioned ports on or about the following dates:—

Lisbon, leave 5th of each month.

Madeira, arrive about	8th,	leave about	8th.
St. Vincent, (Cape de Verde)	,,	14th,	,,	14th.
St. Jago, (Cape de Verde)	,,	15th,	,,	16th.
Bolama,	,,	19th,	,,	20th.
Principe,	,,	27th,	,,	27th.
St. Thomas,	,,	28th,	,,	31st.
Ambriez,	,,	3rd,	,,	4th.
Loanda,	,,	5th,	,,	9th.
Benguela,	,,	11th,	,,	13th.
Mossamedes,	,,	14th,	,,	18th.

Benguela,	arrive about 19th,		leave about 21st.	
Loanda,	,,	23rd,	,,	27th.
Ambriez,	,,	28th,	,,	29th.
St. Thomas,	,,	1st,	,,	4th.
Principe,	,,	5th,	,,	5th.
Bolomas,	,,	8th,	,,	9th.
St. Jago,	,,	12th,	,,	13th.
St. Vincent,	,,	14th,	,,	14th.
Madeira,	,,	20th,	,,	20th.
Lisbon,	,,	23rd.		

"They also leave Hull about once a month.'"

DISCUSSION.

Viscount Sidmouth said that, as Sir Bartle Frere had invited questions on the subject of his paper, which was of so great interest at the present time, he should be glad of information upon one or two of the topics mentioned in it. First, in reference to the harbours on the coast; his own recollection of Durban was that it had a very bad harbour, and the same might be said of the harbour at Cape Town, Table Bay. The only good harbour was St. Simon's Bay, which lay quite out of the way of ordinary traffic. Supposing that, at any future time—without entering at all into politics—the Transvaal country should become developed, he would ask Sir Bartle Frere whether he considered Delagoa Bay possessed sufficient facilities for affording a good outlet for the products of that country. That appeared to be the only port on the East Coast where a natural harbour existed. Durban could hardly be so called on account of the dangerous bar at its mouth. He should like, further, to know whether Sir Bartle could give the meeting any idea whether the Portuguese Government, which holds Delagoa Bay, was disposed to develop that harbour so as to give facilities for future traffic. Another point upon which he would be glad of information was, as to the possibility of forming a depôt at Angra Penquena. Sir Bartle had mentioned the small group of rivers shown on the maps high up on the West Coast, and that European colonists had already found their way in that direction. Driven by stress of weather, some years ago, to seek an anchorage in that region, he had found it very deserted, and had, in the neighbourhood of the Island of Ichaboe, known for its guano deposits, hit upon a very good harbour, which he judged to be somewhere in the direction of the small group of rivers referred to. As Sir Bartle had stated, as he understood, that European colonisation had found its way there, he wished to know whether it would not be possible for a depôt to be formed at Angra Penquena.

Mr. J. Jones drew attention to specimens of some of the minerals mentioned in the paper, which had been furnished by Professor Tennant, including specimens of coal, lead, iron, and diamonds. Amongst the latter was one of the largest that had ever been found in the colony. It was estimated to be worth £10,000 sterling. He would remind the meeting that Sir Bartle was himself a member of the Turners' Company, through the agency of which, by another of its members—the Baroness Burdett-Coutts—the diamond trade had again been brought into eminence in this country, after having been lost since the reign of George II. It was by means of the premiums offered by this lady, that Clerkenwell had now attained the highest point in the trade of diamond-cutting.

Mr. Hall said Sir Bartle Frere's paper had the especial merit of pointing out the great advantages of South Africa as a field for emigration, and he should like to ask whether Sir Bartle, from his intimate knowledge of the country—considering its advantages and disadvantages, the country being destitute of a good *coast-line*, and harbours for mercantile purposes—really thought South Africa a good colony for British workmen to emigrate to. Every means o was possessed by the public of the c Australia, Canada, and the United States the paper should be published, he would from Sir Bartle's own lips whether South opinion—with its disadvantages weighed advantages—was an eligible field for the British settlements.

Sir Bartle Frere, with regard to harbou that he had omitted reading that section of *extenso*, for want of time, having already meeting so long, but he had mentioned Angr it, and had pointed out that one of the great coast was an accurate survey by responsil of her Majesty's service. Fogs were the valent, and good charts and sailing directi would be of especial value. He felt no very considerable coasting trade would, i be carried on from that coast, and that brought into direct communication with E as her Majesty's Government could obtain of the coast. A considerable trade was al on, and steamers ran pretty regularly to near the mouth of the Orange River. T southwards to the group of rivers mentioned passengers at Angra Penquena. It was v give advice on the subject of Mr. Hall's q emigration; but, if one of the best climate could be an inducement, emigrants would ducement in almost every part of South would find no severities of heat or c could thrive there; and, above all, they w settled communities of men of their own b and Dutchmen near akin to us, who w them with as much hospitality as they England, if they did not like to face the make a home for themselves. The more question the more convinced he felt that t regions of the earth where an Englishi happier who was compelled to seek a ho native land. There could be no question Bay was a magnificent harbour, and that railway would make it very serviceable vaal; the meeting could readily draw it sions as to the likelihood of this proving great importance in the near future.

Sir David Tennant (Speaker of the of Assembly) was delighted with t manner in which the history, charac and mode of life in the colony had in the paper, and he could fully Bartle's opinion as to its eligibility a British emigration and enterprise. I could equal it. Of course, emigrants g Africa must expect to rough it. One of t advantages experienced by strangers was of the labour market. Labour there was dependent and less reliable character th whether the fact was attributable to the sparse population, or to the manners of races. They took life more easily, and e greater extent, than working people in Strangers would have that difficulty to but they would find that eventually things down. The insufficient supply of the was one of the great disadvantages; and an of our labouring population, in emigrating they would have to enter the labour market, as competitors with the coloured people. It well to state difficulties, and not to present picture; but any industrious, enterprising, would be sure to do well in any one of the colonies. The climate, the mode of life, ties for communication, all tended to insp pean with confidence in the country, and t assurance that, with diligence, he wou

r and raise himself in the social scale. As regards urs, at Cape Town, the chief town in the colony, Bay was shunned in former times from its ex- e to storms; but what nature had denied, art had ied, and, by means of the docks and the break- , it had now drawn a very large commercial and ing traffic to the colony. It was a perfectly secure ur in all weathers, and it was only to be regretted the docks, when first planned, had not been made . Algoa Bay was more exposed, but improve- s were to be made there, and, when they were leted, a safe and commodious harbour would be ied to a most enterprising port, the Liverpool e Cape; Port Elizabeth is virtually a roadstead, the harbour improvements will, in the end, secure y. On all those harbours a very large outlay had made by the Colonial Government, which con- d to devote a large expenditure to them. From Town a railway ran northward into the country miles, which had feeders on each side all the way, nother railway ran also inland, the two together ing about 1,000 miles in length. Another line miles would probably eventually be extended to mond fields. As those districts now formed part olony, there was, of course, every desire on the the Government, to afford facilities for reaching o, by steamer. As Sir Bartle had said, the only l certain progress was to be achieved, not by ction of the native races, but by the ameliora- their condition, and by Christianising them. nded by moving a hearty vote of thanks to Sir rere for his admirable paper, coming before he did, with his great knowledge of the con- l wants of the country, and as the friend of of South Africa, and beloved by them all.

ace said that even supposing for the pur- trade and of industrial development, Port should never be so improved as to make harbour, Port Natal furnished that require- as proved during the late Zulu war in the ation of the troops. Having known Natal rs, he could say there was no colony to which so readily emigrate, if he had his time over e would advise sober, industrious men to go without the slightest misgiving, for they l that there they would live an Englishman's ved. A circular upon colonisation would be n the Colonial Office in a few weeks, which e every information with regard to Natal, to ing it. Sir Bartle Frere had added another he gratitude of the British public, by supply- his extensive experience, a knowledge of ica, so much wanted in this country, and of se for the future of that great dominion. He pleasure in seconding the vote of thanks.

lger, after hearing the paper, felt inclined to ether the locality of the Garden of Eden een wrongly supposed to lie at the juuction ris and Euphrates, and whether it should not fixed in South Africa. Much was now talked "three F's," but South Africa possessed "three al, copper, and cattle. Its industrial pro- ht be made enormously useful, and he hoped ands of emigrants would be induced to leave nd uncultivable parts of Ireland, and find a South Africa. He trusted that, under the Government of England, and the wise con- f the Cape, Europeans and natives might be py alike under the Divine blessing.

Rawlinson, C.B., pointed out that roads, one of ecessities of a new country, were being con- the Cape Colonies. With railways, roads, and canals, the country would soon become pros- With regard to the labour difficulty, the uld only engage themselves for a term, and would then, in spite of every inducement, return to their people for a period of idleness. But Englishmen, too, were fond of observing St. Monday, and the natives only manifested the same desire for periods of idleness in a more rudimental form. If treated with kindness, they would gradually appreciate and adopt habits of civilisation, and would aid the Europeans in making the South African communities sound and prosperous.

Dr. Mann said it could hardly have been expected that Sir Bartle Frere would have been able to devote so much of his time to the service of the Society as he had in producing the admirable paper just read. One of the most valuable portions of the paper was the point made in it of the necessity for irrigation, in regard to the future of the country. Along one side of South Africa ran a range of lofty mountains, which were deluged with rain for six months of the year. That rain escaped to the sea by a very rapid fall, and for the next six months the country was parched; but as soon as that water should be properly husbanded, the land could be made to produce the most valuable harvests. Throughout many parts of it corn could not be grown at present in summer, but, when irrigated, the finest corn crops in the world would be produced in the dry, sunny season of winter. Since 1857, the most rapid progress had been made in the country. Then no steamers sailed for Natal, and to reach it, he had himself, in that year, had to take a passage to Calcutta, land at the Cape, and go on by colonial steamer. At that time, Natal was occasionally two months without letters from England. Now we read in the evening in London of the events that had taken place in the Transvaal on the morning of the same day.

A Member alluded to the construction of railways now going on at the Cape, and said that the colony, having now got a fair start, would, as greater progress in that direction continued to be made, become one of the finest countries in the world. The mountains along either coast formed natural reservoirs, and, by means of irrigation works, a plentiful supply of water for the country could be obtained.

Sir Bartle Frere, in acknowledging the thanks which had been given him, urged their indebtedness to an old and valued member of the Society for the addition he had made to the evening's instruction by the beautiful collection of minerals he had placed on the table—he alluded to Professor Tennant. He was glad to notice that the trade of diamond cutting had again taken firm root in this country, and that the interesting processes connected with it could be witnessed by visitors in the manufactories in Clerkenwell, through the kindness of the gentlemen who had been instrumental in planting the industry in London.

Mr. Jones added that in a recent competition between diamond cutters in Holland, France, and England, the finest result in polishing the rough gems had been attained by the workmen of Clerkenwell.

The Chairman, in putting the vote of thanks to the meeting, alluded to the gratifying fact that witness after witness should have risen in the room to testify to the extreme value of the paper, and to emphasise the gratifying account given from Sir Bartle Frere's experience of the present condition and future prospects of South Africa.

TENTH ORDINARY MEETING.

Wednesday, February 9th, 1881; Sir Philip Cunliffe-Owen, K.C.M.G., C.B., C.I.E., Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Bolas, Thomas, 2, The Terrace, Turnham-green, W.
Chambers, William E., Eversfield, Sutton, Surrey.
Courteen, Henry, 336, Clapham-road, S.W.
Felkin, Robert William, F.R.G.S., Pennfields, Wolverhampton.
Kirkham, Thomas Nesham, 21, Abingdon-street, Westminster, S.W.
Lee, Edwin, 43, Devonshire-street, Keighley.
Le Rossignol, Francis, 1, Gresham-buildings, Basinghall-street, E.C.
Magniac, Arthur, 36, Hertford-street, Mayfair, W.
Martindale, William, 10, New Cavendish-street, W.
Murray, R. W., 179, Upper Thames-street, E.C.
O'Donnell, William Arthur Maxwell, 4, Gladstone-street, London-road, S.E.
Parr, Samuel, 7, Finsbury-square, E.C.
Pheasant, William Craster, 8, Edwardes-square, Kensington, W.
Rafferty, John Henry, 4, The Terrace, Richmond-hill, Surrey.
Swanzy, Francis, 147, Cannon-street, E.C.

The following candidates were balloted for, and duly elected members of the Society:—

Cole, Alfred Clayton, 64, Portland-place, W.
Cook, Henry, Barrow-in-Furness.
Gibbs, George L. M., 46, Grosvenor-street, W.
Green, Herbert, Tovil-house, Maidstone.
Liardet, John Evelyn, 4, Breakspears-road, Brockley, S.E.
Littler, Ralph Daniel Makinson, Q.C., 1, Plowden-buildings, Temple, E.C.
Lockyer, George, jun., Beaconsfield-house, Godolphin-road, W.
Lovegrove, James, 18, Urswick-road, Lower Clapton, E., and Town-hall, Hackney, E.
Lyte, F. Maxwell, F.C.S., Cotford, Oakhill-road, Putney, S.W.
Payne, Septimus, F.R.G.S., Castle-house, 44, Mildmay-grove, Mildmay-park, N.
Shuttleworth, Joseph, Hartsholme-hall, Lincoln, and Stamp End Works, Lincoln.
Wills, George Sampson Valentine, The Westminster College of Chemistry, 60, Lambeth-road, S.E.; aud 116, St. George's-road, S.E.
Wright, Bryce McMurdo, F.R.G.S., Hesket-house, 54, Guildford-street, Russell-square, W.C.

The paper read was on—

THE PRESENT CONDITION OF THE ART OF WOOD-CARVING IN ENGLAND.

By J. Hungerford Pollen.

In the remarks I am about to make on wood-carving, I shall not enter into the higher aspects of this kind of art. It is, indeed, one side or branch of the sculptor's art. Sculptors of the greatest attainments have left us statues, busts, medallions, and other objects equal to what has been accomplished in harder materials, ivory, marble, and bronze. Many small pieces in the South Kensington Museum, as Sir Philip Cunliffe-Owen can tell you, will fully satisfy those who look for what can be done in hard woods. But I shall have enough for my present object if I can call your attention to carving, not as a branch of sculpture in this higher sense, but as a handicraft of great use, and I may say of necessity, to the architect and the cabinet-maker—carving with sharp tools on softer, only moderately hard, woods. The carving which I am principally concerned, is execute pine and ash. Walnut wood is more e procured in Italy and France than in Eng and it is of so fine and tenacious a grain, t admits of more delicate workmanship than which I wish now to advocate. Wood-carvi unfortunately, at a low level in this country f present; speaking generally, it is almost a lo The only traditional school that has come dowr has its home in the dockyards; even from quarter it is being driven by iron and steel. persons present to-night may have observe Vauxhall-bridge a ship-breaker's yard, and been struck with admiration, as I have, of admirable figure-heads of colossal proporti sometimes to be seen there. They are well- portioned, often dignified, designed and ca with a perfect feeling of propriety for the e they produce, all being calculated to show fro distance. I do not know whether there are g artists still capable of these successes. It w be a real matter of regret that one or two of works should not be preserved as monument studies, rather than be sawn up for firewood.

It would be unfair in a discussion on this ject to omit mentioning, with the highest hon such a carver of fancy work as the late Mr. Ro and some half dozen great London firms of cabi makers. But his work, again, is of too refin kind to be included in the remarks I am mak it is occasional work, equal to that of the Flo tines, Romans, and Venetians of the 16th cent What we want now is such carving as one ou to expect from skilled joiners, from a reg craft, and at moderate cost. Artists, archit furniture makers, and the employers of al them, want good current work, worthy of churches, state buildings, and houses we are bu ing at such great cost all over the country.

How much of it do we see in the great chur of our day, or in public buildings, or in country houses? There is a certain quantit the Palace of Westminster, not of much inte but in general the poverty of this charming of decoration is mortifying. Doorways, d panelling have been starved down to yards, longs, and miles of the product of the mouk plane. Even this much of handiwork is gene replaced by the steam plane. A good deal ev what passes for good carving is produced b machine which multiplies, by mechanical ac copies of any given figure. I suppose, too, most of us have had experience of that di lodging-house furniture met with at wat places—black horsehair sofas, with gaunt b chopped into leaves and curves, and sidebo of the same character. On the other hand, at the eagerness with which old chairs and f ture are bought up, not alone because the old, but because a certain elegance is disco in the simple carving which was all but unive bestowed on them less than a century ago.

Now, carving in wood is as necessary to architecture as carving in stone. Many buil that are not wanting in external dignity and splendour, are finished from foundation to ridge without the help of a stone-cutter, but ar fitted in the matter of wood-cutting within

sole feature that gives interest to some old lon houses is their carved wooden doorway porch, e.g., in Queen Anne's-gate, Westster, and in some by-streets of the City. And remark does not apply to civil buildings only. d-carving is the glory of many of our old :ches, for wood is the material with which rches, like houses, are furnished.

s regards architecture, we have lived to see two rals in this century—the Pointed style, and now, recently, public taste is setting in the direc- of what is called by the venerable name of en Anne, in other words, classic or Italian itecture, as naturalised here in England by es, Wren, and their successors. Both classes of ing are incomplete—absolutely incomplete— out wood decoration.

hitects have been in advance of carvers, and so the exteriors of modern buildings far better rstood than the interiors. Great exertions been made by the late Sir Gilbert Scott, and architects, to train carvers of stone, but much is to be learned and practised by the carvers d. We seem to have stopped half way in ivals; and, as I wish to direct attention to a hat seems to me very serious, I must proceed e these revivals in detail.

gin, then, with the pointed style, consider- rate at which the world moves, and the hanges of fashion, this mediæval style a long reign. Pointed architecture has ore popular in our country than on the it, and the principles of its structure and on have been more widely, perhaps better, od. Now what part has wood-carving had evival? We have rebuilt the Houses of nt, we have just finished the new Law and have erected churches innumerable. many of the latter shall we see carved seats, crocketed canopies, or carved shrines? ogress has been made in regard to the o of civil architecture? The throne in the Lords is, perhaps, the best piece of work lace of the Legislature, but the general of the building are devoid of interest.

et any one walk into Henry the Seventh's in Westminster Abbey, or that of St. at Windsor, and imagine how dull and sting either building would be with- stalls and canopies that rise 15 feet or on either side. The stall work of both to a late date in Pointed architecture—a decay—yet what noble achievements in k these seats and canopies are! The , or hinged seats, have brackets which a sort of seat when turned up. The are supported by masks, grotesque figures, ls, with foliage, gracefully turned. The re quaint, humorous, and always carved rit. The carvers have been their own , and have evidently taken pleasure in rk. Perhaps a certain amount of humor- itness is characteristic of all good carving, the date or style.

t our modern churches look cold and dull, re great sums of money have been spent em, from want of this kind of furniture, general.

again, as to roofs; no structures could be than the great wooden roofs of the Middle Ages. Some were supported by king posts, queen posts, hammer beams, and a forest of smaller supports: intricate, yet not without regularity and order: and always having figures of angels with outstretched wings on the ends of the hammer beams. We have a superlative example in Westminster-hall. Smaller roofs of the same construction are to be seen in some churches of Norfolk. All of these are dependent for much of their interest on the carved figures that adorn them. Perhaps such costly undertakings are scarcely to be hoped for in our times. Yet the hall of Lincoln's-inn, with a beautiful roof, was erected by Mr. Hardwicke forty years since. With the exception of occasional restorations of college halls, I doubt whether we have followed the example set so long ago.

Another fine form of roof or ceiling one would gladly see reproduced more constantly is that of square panelling with carved leaf work on the points of intersection. Most of the ceilings we find in modern churches, or in houses built in the mediæval style, are merely panelled with rails moulded by the plane.

Now, is it reasonable to suppose that carved leaf work of this kind—light, bold, broad, and sinewy —though it is not of extraordinary difficulty, cannot be added to ordinary panelled work, because of the cost? As we see it in old work, it is simple and coarse, but effective. It does not require an accomplished hand for its execution. Yet the quick, ready hands from which such work ought to be producible with ease and at moderate cost, cannot be found.

In making such a statement, I feel bound to acknowledge the services to wood sculpture of Mr. Brindley and his pupils. He has restored stall work and tabernacle work of all kinds. But such skill is confined to very few firms in London, Peterborough, and perhaps one or two other favoured cities. We have nothing like the amount of skill and talent in the wood-carver that we can resort to in masons and carvers of stone.

If the mediæval revival has not seen a lively and growing school of architectural wood-carvers, ready to decorate stall work and tabernacles, panelled walls and ceilings; neither can we point to any solid achievements in modern mediæval furniture. One or two light and well-constructed pieces, such as sideboards, buffets, &c., have been seen in the great International Exhibitions. But in furniture, far higher accomplishments are required of the carver. Those old cupboards, cabinets, buffets, chests, of French or Flemish origin, which are to be seen in the South Kensington Museum, and picked up in shops, are carved not with mere leaf-work, but with figure subjects. Little compositions, illustrating old legends, form the chief decoration of this old furniture; but we look in vain for it in our own reproductions.

If we are to go on building, fitting up interiors, and making mediæval furniture, it is in the direction here indicated that we want training and practice. Something should be said as to the treatment of carved woodwork and carved furniture. Old work was partially gilded. In roofs where it had little light upon it, it was painted and gilt. It was never covered with glossy varnish, as so much of our modern woodwork is.

Let us turn now to the decorative woodwork of

a later period, spoken of sometimes as a sort of halfway step in the direction of Italian art, that purely domestic style which we call Elizabethan. It belongs, in reality, to the earlier revival in this country of classic or Italian architecture. It was neither so artistic in outline, nor so fine in detail, as the art of the time of Henry VIII. He had Holbein and other foreign artists in his pay—men educated under the revival. The period of Elizabeth was later. The kingdom was more or less isolated from Continental Europe, and our style of architecture, and of the woodwork and sculpture that belongs to it, became national. It is the Elizabethan house, its interior panelling, its fanciful carving, and massive furniture, which has retained so great a popularity down to our own times. Country houses of this kind have been re-fitted, and others built in recent times, and we continue to build them still. All the woodwork of the old houses has a distinct and national character. But it had this character owing to certain national prejudices, and to the difficulties that stood in the way of sending artists to Italy, to study in Rome or Florence, as was the custom of the various States of Germany, Spain, and the Netherlands.

Nevertheless, builders and projectors of Elizabethan houses aimed at following the lead of the artists of Italy. In that favoured land, the enthusiasm for antique art, and the success with which it was cultivated, were astonishing. Italian painters were often architects as well. They designed churches and houses; they caught up the threads of old traditions, and carried them out into a thousand delicate developments. Wood-carvers adopted the mouldings, capitals, brackets, arabesques, and leaf-work, which they found on ancient monuments. Though they borrowed these details from architecture, they modified, simplified, or multiplied them, according to the opportunities of the objects they had in hand, and the nature of the materials in which they had to work. In this respect, they did what wood-carvers had done for the Pointed style. The egg and tongue, the drip moulding, the ogee mouldings covered with leaf-work, had all been adapted to their service. But, in the hands of the earliest and finest carvers, an immense variety was introduced into these important elements of decoration. So also with capitals and brackets, the classic acanthus was put to universal use. It was varied in ten thousand ways. Yet we recognise in all these Italian capitals, or brackets, or scroll work, in which this leaf is used, the old type. We cannot but see, moreover, what a pregnant type of foliage it is, and how inexhaustible in its application, offering an endless field for variety, and yet preserving that unity which is one of the great principles of art.

Here are examples of a large and a small piece of furniture, belonging to the best period or Italian wood-work (bench and mirror). We must keep this Italian wood-carving before the mind, if we wish to understand that of our own country.

The peculiar character of our own Elizabethan art, and, indeed, of the contemporarary carving of France and Germany, and still more of Flanders and the states of the house of Burgundy, was due to the firmer hold in those countries of old mediæval ideas. We, in England, retained a great love for the old houses, old feudal customs, the state and hospitalities of former days. The Elizabethan house was still surrounded by a mo[at]. It had courts and gate-houses. The doors w[ere] old ledge-doors of massive oak, sometimes pie[rced] with shot-holes. Then we preserved the tradition of one vast room, or hall, to which [the] drawing rooms, and libraries, and galleries [were] offsets. Into the hall travellers and wa[yfarers] were welcomed. The entrance was a pa[ssage] panelled off from it, so that access could b[e had] through it to the rest of the house. Ove[r this] passage a gallery commonly led from one s[ide of] the house to the other, still across this grea[t hall]. These panelled screens and galleries are richly [deco]rated with carving of several kinds. A hug[e fire]place was provided on one side. The upper [end] was raised, and the handsomest seats were [placed] there. There sat the guests of highest ran[k on] the wall side only. The salt, the emblem [of] hospitality, was placed in the middle of the [table]. Guests of inferior rank sat at tables run[ning] down the length of the room. The walls [were] panelled with oak, to a height of ten or twelve [feet]. These noble halls are, as we may say, "[the] making" of the Elizabethan house, as they [had] been of the earlier Tudor houses, and of old cas[tles] and manors, and granges, time out of mind. [The] architectural diposition, inside and out, was, [in] great measure, dictated by that of the old poi[nted] style. The Renaissance was adopted with [en]thusiasm, but the parts and details were fitt[ed to] a system of mullioned windows, pointed ro[ofs], and Tudor arches. Builders thought one w[ay], and expressed their thoughts in a borro[wed] language. We see curious façades, displaying [tiers] of columns of the "Five Orders," one over [the] other. As to details of wood-work, the firep[lace] was put together over a Tudor arch, like all [the] doorways of the house. Round arches were [of] late adoption. The hall-screen had clas[sic] columns, capitals, and brackets. Terminal fig[ures] with Ionic capitals, supported the large and [pro]jecting cornices. Both in these large screens [and] the chimney fronts, the details are curiously m[ixed] in character. There are Doric columns from [the] ground; a second series over them; d[eep] recessed panels, fronted by arches; over [all] generally the heraldic achievement of the fa[mily]. The boldest carving is often seen in the detail[s of] heraldic carving; the mantlings of the he[lmets] coming down in wide sweeps of wood carved [in] relief. Every detail in this kind of carving [re]tained to a great degree its abstract and con[ven]tional design. In the richest and best exampl[es of] screens and fire-places, figure sculpture is empl[oyed]. The virtues, for instance, in hooped petticoa[ts and] classic armour. Arabesque work, that is, s[atyrs'] heads or human masks, with scrolls of fol[iage], were carved with spirit, and used to cover imp[osts] or panel surfaces, or coupled together and sp[read] out into cornices, and the upper borders of [con]tinuous panelling. Another favourite element [of] decoration is that scroll work of flat relief, w[ith] bosses of turned and split wood at intervals, ca[lled] strap-work. The cornices of chimney-pieces [and] screen divisions, are often interrupted by wor[k of] this kind lapping round it, and passing over m[em]bers of the structure above or below. It w[ould] seem to be an idea borrowed from the old [iron]work that formed so important a feature in

ors, and other wood-work of the middle his strap-work, and the larger surfaces of heraldic scutcheons, borrowed, probably, notched and curled edges of boiled and leather, are very effectively employed in han wood-work. In one form or another, rced, plated, or curled decorations are met all sorts of surfaces. They are of great

again, look at the furniture of this system. e acorn table legs, with gadroon ribs on the nd acanthus leaves on the under surfaces. e acorn shape elongated serves for stair s, and for supports to side-boards and fronts. Other notable objects of furniture edsteads. The bed heads are divided into panels, and the tester is supported by rn posts, sometimes by fluted columns, minished as they rise. Rude terminal figures are generally introduced into the The tester is a panelled frame.

' the details of Elizabethan woodwork are be Italian. The mouldings are partly m the plane, partly fitted in with billets ldings, but worked, it must be remem- uneducated carpenters, joiners, and

ce Elizabethan carving detail by detail, faults, short-comings, and inconsisten- ims at a graceful and beautiful ideal; ied out—often ignorantly—as best it can ognise in it a real character; it is full of d even grotesque incident, but it speaks of its day. And this is what gives and meaning to good intentions in the e Elizabethan age was full of a strange hought—chivalry, of a kind hospitality, hirst for new adventure, for new know- ffectation and simplicity—of generosity, rsty for wealth, and stained with cruelty. tempt to reproduce wood-work belong- at period, we must do it with some ve for the interesting side of an age so : and of art, so full of inconsistencies, or compound ideas. If, on the other hand, copy this old work, and with labour and llow its oddities, without knowing how their art in our turn, as they modified t in theirs, we do but reproduce the side of it. The neater, the smoother, the anical the imitation, the more glaring be- sults of our work. Any architect who has e work of this kind in hand, and to get l, will, I think, agree me as to the un- y results he has often to meet. It is embered that the wood-work of the n time was cut by country workmen, stonishing that hands so well practised al business of carving should have been very county in England, from Northum- Cornwall. Could we go to any assize and reckon on finding two or three od carvers and their apprentices, ready out panelling, heraldry, furniture—all nted to fit up a stately palace accord- taste of the day? No; I fear that out , or Peterborough, or one or two other owns where some man of special train- nade a school for himself, we should what we want in vain.

Well, let us turn to a later fashion, that which is becoming so popular now under the name of Queen Anne.

Two great architects put the principles of the Italian Renaissance into exact form in the 17th century—Inigo Jones and Christopher Wren; Vanbrugh, Chambers, Kent, Adam, and others followed. Numerous examples of the wood-work designed by these artists remain in public buildings, churches, and dwelling-houses. They had fewer decorative resources than their contemporaries in Italy and France. One great name, however, belongs to the profession of wood sculptors of the century, that of Grinling Gibbons. His foliage, flowers, birds, and other details have the sweep and delicacy of Nature, so far as an approach to Nature can be carried in decorative carving. All the carving of the 17th and 18th century may be called architectonic. It was put to the service of interior decoration. Let us notice it in detail. Houses were no longer built with the great halls already noticed. Churches, however, and large public halls, such as those of Greenwich Hospital, Kilmainham Hospital, in Dublin, and other places, were often screened off from the doors. Such screens are regular and orderly façades, with arched entrances, surmounted by a pediment. The walls of these structures, and of rooms generally, were divided by columns or pilasters, fluted, and with carved Corinthian capitals. The panelling is no longer of the old sizes, but in very large divisions; one of dado height, with tall panels above. They stand well out, and are enclosed within bold roll mouldings, projecting beyond the surface of the panels. Where these panels are of great size, as in some public halls, the mouldings were carved. Wreaths of leaf-work stand out in relief on the architraves, that finish the wall panelling; and that surmount the openings of fireplaces and doorways. These doorways, even inside the rooms, are generally covered by a pediment. The picture frames that form the upper portion of the chimney fronts, are also surmounted by a pediment, pointed, or round, or interrupted in the middle. Garlands of leaves or flowers, with bold side brackets, in the form of volutes, over which the foliage falls, or from the eyes of which another scroll of leaf-work springs, form the side decoration of the chimney fronts of the more correct Wren period.

I should be taxing your patience too far were I to attempt to follow the wood decoration of this fine character through all its details. We may, however, notice some special features, out of which the wood-fitters and joiners of the last century may be said to have made their decorative work, and these are the very elements we want our wood-cutters to have at command to-day.

First, figure sculpture. Somehow in this country, our wood-carvers have never been strong in this essential matter. Even in Wren's time, and that of his successors, beyond an occasional artist, there does not seem to have been any possibility of commanding the services of carvers educated to this extent. We find heads—of cherubs, of women, &c.—occasionally well modelled and finished. But the contemporary Italian and French wood-cutters could beat us out of the field in this respect.

Of foliage, the English carvers were masters

As for the foliage of Gibbons, it was of all kinds, and animals were introduced among the rolls of his stems and flowers. It was abundant, and yet delicate. Generally, he used lime-wood; and his work is such as naturally found its place as an addition to actual architectural details, and was applied to friezes, or placed under pediments, or on the architrave fronts of chimney pieces. Such carving as that of Mr. Rogers, had more of it been devoted to decoration, would be invaluable in these reserved spaces. (Some of Gibbons's carving can be seen over the communion-table of St. James's, Piccadilly.)

It is to be noted that, in architectural carving of this period generally, the acanthus and the vine leaf are the only leaves employed. There is, also, the honeysuckle ornament, and anthemion, or leaf arrangements similarly composed. In later work—Adam's, for instance—the olive, or a leaf of similar shape, was added. Speaking generally, however, the leaf used is the acanthus. It is cut on capitals and under brackets. Portions are composed over the surfaces of mouldings, in a hundred varieties, and with endless inventiveness. Yet it is always recognisable, and helps to preserve the unity of the general design of the decoration. The little, feather-shaped leaves on the correct English Corinthian capitals seem to me the poorest and driest examples of its use.

On the furniture of Queen Anne's time you see the acanthus leaf on the bulging legs of chairs and tables; and broken pieces of it on the tops of bed testers, on chimney pieces, and round looking-glass frames. The finer, more wiry work of Adam, and the Chippendale furniture, is decorated with sprigs, or portions of this leafage. And some small Adam mouldings are entirely worked in tiny acanthus, even when the width scarcely reaches 3-8ths of an inch.

As to mouldings, something may be said. Mouldings, of course, represent the decoration of edges. Wood being framed together often in different thickness, these edges have to be provided for. The decoration of wood edges takes so large a place in the arrangement of panelling, of picture-frames, of fireplace openings, doorways, and so on, that it forms the most noticeable decorative feature at the command of the carver.

It is worth observing, how few the mouldings of these periods are. They are derived from classic Rome. There is the egg and tongue; leaf mouldings; billet mouldings, made up of small square dies separated by hollows; bead mouldings; ribbon mouldings (guilloches); square key frets; the Vitruvian scroll; little else. Yet few as these are, the shades of variety to which they lend themselves are endless; partly by the size, partly by the shape of the egg and the anchor, or by carving the egg surfaces, or by various treatment of the acanthus leaf-work, where it covers the surface of the moulding lines.

The carvers of the last century cut these in soft pine, over long lengths of moulding; often in beautiful curves and turns of the leaf. A slip of the chisel would have destroyed the side of the doorway. There are examples in the Kensington Museum, taken from old London houses, quite complete, and of masterly execution. Could we be sure of getting such sharp, free-handed work done now?

Then as to furniture. Chambers introdu[illegible] Chinese fret-work, and the Chippendales cut th[illegible] delicate pierced cabinet tops, and china she[illegible] and table edges, which are so highly prized [illegible] The carving of looking-glass frames took the [illegible] of little Chinese gardens, with rocks, gro[illegible] argus pheasants, and other curiosities do[illegible] edges. As far as architectural carving wa[illegible] cerned, how very few and simple are the el[illegible] of this old carving—carving so much in [illegible] now. I wish I could think that our Queen [illegible] style was fitting itself out with these simpl[illegible] effective, elements of carving. It is a k[illegible] work which all carvers could learn; whic[illegible] always return full and redundant measure o[illegible] and agreeableness, for the modest skill it re[illegible] Some London firms well understand this k[illegible] carving; but only two or three establish[illegible] Putty, or papier maché, or other moulded [illegible] tion, are generally provided by the builder. [illegible] at our picture frames, and the feeble meander[illegible] of putty over their surfaces, and compare t[illegible] with the simple honest mouldings of the Van[illegible] frames. I do not forget the admirable ob[illegible] we have seen at various International Exhibiti[illegible] They are triumphs of skill, and the exhib[illegible] English, French, Italian, or German, deserve [illegible] honour. But these are objects of special and [illegible] traordinary exertion of artists, and are m[illegible] mental—not works that can be placed within [illegible] reach of ordinary buyers, or made without exc[illegible] cost of time and labour.

I shall conclude with one or two observati[illegible] which I hold to be of the first importance, [illegible] which, I think, may be deduced from the foreg[illegible] remarks. First, all decorative carving in w[illegible] mediæval and Renaissance, has been intim[illegible] connected with architecture; and, further, [illegible] been architectonic in design and details. [illegible] tabernacles, pinnacles, and spires of medi[illegible] stall-work, triptychs, and so on, are design[illegible] the lines of external architecture. So with [illegible] pediments—really, small roofs—pillars, cap[illegible] architraves, and so on.

How is it that wood, so different a material f[illegible] stone, and being used in-doors under such diff[illegible] conditions from those that govern exteriors, sh[illegible] fall under the rules and lines of actual arch[illegible] ture? Ought not all wood-work to be gover[illegible] some distinct principle of decoration? I b[illegible] that most designers have asked themselves [illegible] question, and battered their brains for an ans[illegible] In many cases the honest endeavours of many a[illegible] tects and cabinet-makers show that an answ[illegible] been sought, and the general results show how [illegible] it has been found. Sooner or later, I believ[illegible] must all come round to the principle which [illegible] prevailed so generally, if not so universally, i[illegible] past. Good art maintains its unity. Archite[illegible] is the master art in a certain true sense. Scul[illegible] and painting find their true places und[illegible] shadow. Great buildings, cathedrals, te[illegible] abbeys, and halls of justice belong to all wh[illegible] see and use them; in the case of religious b[illegible] ings, to all who care for religion in the w[illegible] world. Pediments, gables, arches, columns, a[illegible] on, not only represent fundamental geom[illegible] figures, which rule the composition of deco[illegible] detail, but they are parts of structures the [illegible] imposing, the most intimately associated [illegible]

national life, that come within the range of our imaginations. They connect interior decoration with the structure for which they are intended, and give a certain life and purpose to details that would not effectively stand alone. On this part of the subject there is much more that might be said, but, after all, the strongest proof of the necessity of the connection I advocate, is the broad experience of all history.

Of course, the architectonic character in question is one of analogy. Wood carving should be suggestive, not imitative, of architecture. It is on a lighter and a broader scale of proportions, in accordance with the continuity of fibre and tenacity of grain of wood as contrasted with stone. The most cursory study of examples will set this clearly before us.

Another observation I make is on the extreme simplicity of the elements out of which such endless varieties, both before and since the Renaissance, have been produced in carving—one or two kinds of foliage, half a dozen types of moulded edges. Some of these are convex in sections, some concave, some undulating.

One of the most dangerous stumbling-blocks to modern carvers, men who have not well read or thought the subject out—one of their most serious impediments—is the vast variety of fragmentary examples in museums. They belong to various periods, and represent many phases of change. The present aims at producing something new. In novelty—actual novelty—is rarely to be had. The traditions of art, descending through the long course of the past, reveal to us the unity of principle which they maintain, not less than the simplicity of instruments, by means of which successes so many and so various have been achieved. Michelangelo got his inspirations from studying a few sarcophagus fronts and other marble fragments in a garden. The architects of his day, and of Wykeham's, and of Wren's, began by mastering the few decorative details in use in their day. What a slender stock of tools, for works so infinite in variety, that have come down to our time! They were students of nature as keen and true as ourselves, but they sought variety rather than novelty, perpetual freshness of application, of few but inexhaustible principles. What they did, sculptors and carvers, decorative carvers, can do in their degree in our days.

Then, again, if to narrow our field is in reality to increase our insight and inventive powers, it follows that modesty, self-restraint, and simplicity of aim, should govern our designs of ornamental carving. Look at the decorative carved work, such as one sees, for instance, on sideboards; bunches of game, pheasants, hares, rabbits, hanging all over it. Some of these compositions are skilfully carried out; but the impression they produce is that of redundance, crowding, want of discrimination, absence of effect, and work often wasted. You see ornamental details heaped on mirror frames, cabinets, chimney pieces. Such compositions are vulgar, because the artist has chosen details, perhaps from several good original examples, which do not agree with each other. They are like fine expressions or musical rhymes torn from their proper contexts. To compose really well, to know exactly where to stop, and how to make a simple piece of foliage or figure set off the space it fills; to possess what we mean by a correct taste, is partly a gift, partly the fruits of thought and observation. To pick and choose, and mingle together in the search of novelty and variety, is the least likely way to acquire it.

If the desire to put too many ornaments is the danger of composition in carving, so to try to follow nature too far is the danger in execution. No leaf, or flower, or other object followed up to realisation, really decorates the frieze or the the wood-work on which it is carved; it is better to carve it complete, and lay it on a table, or in a cabinet. When we decorate a frieze, or a cabinet, the ornaments are to be portions of the thing decorated, and worked out, some more, some less, according to the size, shape, amount of plain surface, and so on. Leaves die into the surface, or are only indicated over many places, on the bell of a capital, the tympanum of a pediment. Points in the leaf are here and there fully developed. Figures in bas-relief are often of extreme flatness, or partly flat and partly brought fully out and undercut. Much foliage that would be excellent if indicated only, one sees absolutely spoilt by attempts to elaborate petals, leaves, tendrils, and so on. Even natural proportions have frequently to be modified. Carved objects will often not look correct without this severe treatment.

Opportunities of careful rendering of nature are never wanting to the carver, and his finer skill and deeper knowledge produce their true effect, when he knows how to keep other portions of his work subdued, or but partially defined, and strictly subordinate to architectural requirements.

DISCUSSION.

The **Chairman** said there was perhaps hardly anyone else in the country so competent to give such an interesting and instructive paper as Mr. Pollen had just read, and he thought he must have had practical experience, not only of carving in stone, but in wood also. It had occurred to him, while listening to the paper, that it was a great pity that his words should only be heard by those then present, and how well it would be if the lecture was repeated in workshops, or centres of industry, where he was sure it would not only be listened to with interest, but would be followed by good results. In England, we were in a very peculiar position as regards the art of wood-carving. He had before him the prospectus of a School of Art Wood-carving, which was founded in 1879, by a few of his colleagues at the South Kensington Museum, who, with an eminent manufacturer and other gentlemen, banded themselves together for the purpose, one of the most active being the gentleman who had the direction of the science schools throughout the kingdom. He thought Colonel Donnelly must have taken this up as a kind of relaxation, probably thinking it not so dry, and a little more artistic, than what he had to do, and did so successfully, in connection with the science schools. This was only started in 1879, whilst in Austria, Hungary, Switzerland, and most countries of Europe, the Government promoted schools of wood-carving in all parts of their dominion, and one of the most interesting sections of the Exhibition at Vienna, was the one showing the results of the teaching throughout the primary schools of the Austro-Hungarian Empire. This school was still in its infancy at the Albert-hall, but it had already attracted the attention of the City Guilds of London Institute for advancing Technical Education,

and he trusted that it might become a normal school for other schools throughout the kingdom. After all, wood-carving was a thing which interested almost everybody; boys and even girls were very fond of carving, and they often carved most inconvenient things with their pocket-knives. Now, if this disposition were turned into a right channel, and they were taught in the various schools how they might make use of this love of carving for the decoration of their houses, great good would be done, and much evil would be avoided. It was a matter which ought to be taken up generally, and he trusted Mr. Pollen would repeat his lecture in other parts of the metropolis. He heard, the other day, that 60,000 new houses were built in London and its suburbs every year, and, of course, with such a state of things, there could not be much time spent on decorative wood-work, but there were many people who would willingly introduce wood-carving for decoration, if there were carvers to do the work. He believed that until latterly there had been no means of instruction whatever, except in some of the large firms, until Signor Bulletti, the instructor of this school, tried to start a school of his own. They owed his presence in England to the liberality of the late Duke of Northumberland, and some of the most marvellous carving of modern times was to be seen at Alnwick Castle, as the fruit of his work. He regretted that Mr. Pollen had not applied to the South Kensington Museum for more specimens to hang upon the walls, for he was sure they would have been lent. After all, the South Kensington Museum was one of the children of that Society, and they were always pleased to have an opportunity of showing honour and respect to their parent, the Society of Arts, which initiated the Exhibition of 1851, and had supported every movement connected with instruction throughout the kingdom.

Colonel Donnelly said he had come to learn and not to teach, and he certainly was not prepared to enter at a moment's notice on the large subject of wood-carving generally, but he might say a word or two about the school which had been alluded to as one of the means by which the art might have a chance of revival He spoke, of course, of wood-carving in the architectonic sense, not as developed in some of the beautiful specimens exhibited, which might be looked upon more in the light of pictures than as accessory decorations. The school was really established with the aid of the City companies, and fortunately they had rooms lent them by the Royal Commissioners for the Exhibition of 1851. This school had been a striking example of the difficulties which were met with in attempting to found technical education, by which he meant, not general or special science or art-teaching, which might be useful in any particular branch of art or industry, but the absolute learning of the *technique* of the art. If you attempted to teach the *technique* of an art or trade in existence, those whom you taught could not get employment in the trade; they had not been entered in it, and it was almost impossible for them to get into it. If, on the other hand, you took up an art which had nearly died out, with a view to its revival, you found it very difficult to get pupils, because they naturally asked, "Shall we be able to find employment for our art when we have learned it?" On the other hand, those who might employ them did not design for wood-carving, because the art having died out, there was nowhere where they could get it done in the quantity and with the rapidity necessary in carrying out large business operations. This was really one of the great difficulties in the way, which would only be got over in time, but he hoped that some architects, who were now designing Queen Anne mansions by the hundred, would remember the School, and give them some orders. They were getting into a state in which a good deal of really good work might be carried out, though they could not undertake very large orders at present, but if they were encouraged, they *would soon get more pupils*, who would see their way to an occupation in life. One great advantage w
was an art which ladies could follow, an
as skilful in as men. They must, however, h
artistic feeling, and must first learn dra
modelling. It was not to be taken up by
therefore, and when persons had learned dra
had some art appreciation, they did not know
wood-carving was an occupation by which t
earn their bread. If the work was to progre
be with the co-operation of architects; but
thank Mr. Pollen for the opportunity he ha
advertise the schools, and perhaps if some of
papers would be kind enough to abuse them
would also further assist them.

Mr. Rogers said it seemed to have been as
some time past that the art of wood-carving i
was a lost art, but he could not agree to this
large proportion of the wood-carvers in Eng
especially in London, had not for many years
employment; he might safely say that on
them had been out of employment three mon
year for some time past. It was a lost a
because it was not looked for. If the work
had described had been inquired for during t
years, it could be had. He saw men there, w
he knew, though he might not have spoken
themselves, capable men, who had not l
employed. He first heard the statement ab
five years ago, since when it seemed to have
in the public mind, and he was glad to
opportunity of correcting it. He believe
from an article in the *Builder*, stating
architect wanted to get some work done i
and could not get it done there, and had
to Paris. A great deal was made of t
time, but the gentleman explained afterwar
trade just then happened to be very busy
work, which was wanted in a hurry, could n
in time, but he had all he could executed in
and he was much better pleased with the En
than the French. These explanations, how
very often not seen by those who saw the
tions, and so it got about that work could n
in England. He did not believe, however
architect would say so. There was a great de
rate furniture being made which was never
public. Customers would order things
own taste, or from a design by their
and, as soon as it was done, it
home, and, therefore, there was no oppo
judging of it by the general public. Wh
acting, in connection with Mr. Donald
recent Exhibition, he had a letter from
Mr. Aumonier, saying he had some fine t
completion, but he could not spare them fo
time; and asking if he might be allowed
piece for a fortnight, and then take it away
another, and so keep his work before the pub
was not permitted; but it struck him th
some suitable place in London could be fo
carvings, as they were finished, could be a
few days before they were sent home, the p
be better able to judge of the real position
He had been much pleased with the paper,
like to move a vote of thanks to Mr. Pollen.

Mr. Mansfield thought Mr. Rogers's rem
worthy of consideration; and he could exem
by his own experience. A short time ago, h
fine pieces of furniture in the warehouse, ju
and by chance Mr. Graham and Mr. Donald
in, and saw them; they asked if they might
workmen to see them, to which he readily
the first night 300 men came; many of the
pleased that they asked if they might come
next night and bring their friends; and on
ing evening more than 1,000 came. He wo

stand that kind of thing if he could, even to opening the place on a Sunday. It was certainly to be regretted that things were passed out of hand so rapidly, that the working classes had no opportunity of seeing what was done. His opinion was, that as good work could be done now as ever, if it were ordered.

Mr. Wolstencroft referred to the fact that many wood-carvers had been thrown out of employment by the abandonment of carved work on carriages. The plan of exhibiting good work for a short time was a bad one, because manufacturers did not care to make things specially for exhibitions where they were locked up for six months and perhaps not disposed of at all. He had seen in the manufacturer's shop, a few days ago, a beautiful specimen of wood-carving which was sent to both the Vienna and Paris Exhibitions, and was unsold.

Mr. Mackay said he was a member of the Wood-carvers' Society, and knew something about the subject. He and his fellow members of the trade were much pleased to find this subject engaging the attention of the Society, and of the gentleman who had read the paper, but there were points in it with which he could not by any means agree. There was a disparaging tone in it, which he doubted very much if those practically acquainted with the subject would endorse. No doubt wood-carving had passed through several phases during the last forty years. In 1851, there were many faults; in the Paris Exhibition of 1857, and the English Exhibition of 1862, there was a change for the better; and in 1878 it found its proper place, which it had not done before. Mr. Pollen had spoken of sideboard carvings being overloaded with game and so on; but they did not see such things now, and he did not think the improvement had been dwelt upon as it deserved. As to the idea of the art being lost, and that it was only to be revived by this school which was directed by Signor Bulletti, he dissented from that altogether; there was a lot of life in it yet; and he failed to see how Signor Bulletti, with all his ability, and all the influence he had to back him, was going to revive it. Nor were the works exhibited last year at South Kensington such as would warrant those who had produced them, and their friends, in believing that it must mean that or nothing—that they would be able to gain anything like a subsistence. He thought they were going on the wrong road, which could only lead to disappointment. His feeling was that, although help could be given out of doors, and special instruction could be afforded in schools, the workman must remain in the workshop. It was there that the man or boy could be trained to be a workman. As to the other sex, with all due respect to the ladies, he believed that, except as a pastime, it was rather a mistake for anyone to advise them to take it up as a remunerative employment. No doubt workmen were not so advanced as they should be, but if they were to do much, architects must come to their assistance, tell them what they wanted, and give them directions. If the architect would put up with sham and shoddy, the public would also, and the workman had to walk the streets, or to produce that for which he had a distaste, which did no credit to him, and brought the art into disrepute.

Mr. Sandilands (secretary of the Wood-carvers' Society) said there were several present who could speak better as to the present state of wood-carvers than of wood-carving. When he heard of this lecture, he wrote to the Secretary of the Society, who kindly sent him six tickets, but if he had sent him one hundred, he could have used them all, and have brought that number of men who could have spoken feelingly as to the present condition of wood-carvers. It seemed to have got abroad that the wood-carver was almost an extinct animal, and that the art had to be revived by some means or other, and that this school at South Kensington was to be one means of doing it. Colonel Donnelly thought that if the school was abused a little, it might be to its advantage, and he could assist him with any amount of abuse; but if that was the object of reviving wood-carving, it was not one which wood-carvers would want to assist. If it was to compete with the profession, and to invite architects and manufacturers to send work to it to be done by the students, and young men, who had little or no pay, how was it possible that men established in business, who had to pay liberal wages to their workmen, could compete with them—supposing that they were able to do the work—which remained to be seen. There were any amount of wood-carvers equal to any work which could be entrusted to them, but they could not stand alone, like painters, or sculptors; wood-carving was an accessory art, which depended on architects and designers for its existence. He would undertake to say that any number of men could be found in London to carry out all the work which was required, and if that was not the case at that moment, more would soon come forward. When work was wanted, it had always been found that men soon qualified themselves to accomplish it. The Houses of Parliament had been alluded to as showing unsatisfactory work; but it must be remembered that when they were built, that kind of work was very little known; but, at the present time, any quantity of it could be done equal to anything to be seen in old examples.

Mr. Pollen said very possibly he had failed to make himself fully understood as he had intended. He started by referring to several specimens of fine work, and said that the best work could be done to-day, as good as that of the old Venetians and Florentines—there were examples in that room, only just completed, as fine as anything Grinling Gibbons did. His point was not that it was a dead art in that respect, but he asked the question as a matter of fact—how much wood-carving did you see in modern Queen Anne houses? There were all sorts of cornices and ornaments, but they were all mouldings. He built a house himself, not long ago, and the first thing which occurred to him was, to have the ledges and styles of a pair of mahogany folding-doors carved. He obtained estimates; and he had specimens in his hand, the price of which was 2s., 1s. 9d., and 1s. 6d. a foot. If he had had the doors carved in that way, it would have added £10 or £15 to the price, which hardly any one could afford. Wood-carving was practically a lost art in that sense, that the price at which you could get it done was prohibitive—it was out of everybody's reach. What was wanted was a simpler style of thing, which an architect could order 500 or 600 feet of at a moderate price. The fine specimens referred to were, he believed, only turned out by very large firms. As to the school, he had only referred to some of the specimens as having been produced by it. He believed it was not started by Signor Bulletti, but by Colonel Donnelly. His object was to train people to common-place ground-work; so that if there was a demand for it, it could be had.

The Chairman, in moving the vote of thanks to Mr. Pollen, said they might congratulate themselves that there had been several members of the Wood-carvers' Society present, and he wished there had been, not six, nor sixty, but a hundred and sixty. He hoped there would be another paper on the same subject, when the members of the Wood-carvers' Society would come in a body. But however those who were present might dissent from certain remarks made by the lecturer, they would, at all events, acknowledge his kindness in coming forward and drawing attention to the subject, and he trusted they would so prepare themselves for a future occasion, as to really benefit the public. To that end, he would announce that any number of copies of the *Journal* containing the

lecture would be sent to the members of the Wood-carvers' Society, if Mr. Sandilands would send word to the Secretary how many were required. Mr. Mansfield's remarks deserved the greatest possible credit; but he was not astonished at any act of liberality on the part of Messrs. Wright and Mansfield. It was like them to call together their competitors in trade to see what they produced, and he only wished other firms would follow the example. It would be an excellent thing to find a place where such objects could be sent for a few days; workmen would learn to respect one another, and they could have no better critics than those in their own trade. He knew of no work more appropriate to the Society of Arts than that it should endeavour to institute such an arrangement. Some had objected to the idea of wood-carving being in a dying state, and it was a great satisfaction to know that they need never say die; and, in order to show architects and gentlemen who were willing to spend money on their houses that it was not an art which had died out, they ought to look forward another year to some special exhibition of wood-carving as applied to architecture. That would show the world generally that there was life in the old dog yet, and that there was no reason to despair.

The vote of thanks was carried unanimously.

NATIONAL TRAINING SCHOOL FOR MUSIC.

The following report, as to the action of the Society in founding the School, has been prepared by the Secretary, by order of the Council, and was considered at a recent meeting:—

1. In 1860, negociations were commenced between the Council of the Society of Arts and the Directors of the Royal Academy of Music, on the subject of the reform of the Royal Academy. In November of that year, a Committee was appointed to consider the subject, and to confer with Sir John Harington and the Directors of the Academy. In May of 1861, this Committee reported, stating what they considered the principal objects of a Royal Academy of Music, and stating that, in their opinion, an enlarged scheme of a National Academy of Music should be based on the foundation of the present Royal Academy. In February of 1865, the Council appointed a Committee to consider the state of Musical Education at home and abroad. In June, 1866, this Committee published a voluminous report, containing the evidence of a number of musicians and others who had been examined by them. The report stated that for the proper cultivation of Music, a National Academy of Music, supported by Parliamentary funds, was requisite, and that such an Academy should afford gratuitous education to persons having great musical gifts, who, after their training, would become professors of Music. The Committee recommended that the Academy be open to the public on payment of fees, that scholarships should be endowed, and that the Society of Arts should found a limited number of such scholarships. They also recommended that the application made by the Royal Academy, in 1854, to the 1851 Commissioners, for a site on the Kensington-gore Estate, should be renewed.* After the publication of this report, negotiatio[ns] [appear] to have been continued with the Academy, [but they] were brought to a close in 1868, as appear[s from a] letter from Mr. T. T. Bernand, addressed [to Mr.] (now Sir) Henry Cole, by the fact that the A[cademy] found themselves unable to surrender thei[r ...] without going to considerable expense.*

2. In December, 1870, the Musical Co[mmittee] recommended the Council to make arran[gements] for a series of concerts to be given at th[e] Albert Hall, the profits of such concer[ts to be] applied to the establishment of a National School for Music. Six concerts were giv[en, with] the net result that a loss of about £100 [was in]curred by the Society.

3. In the opening address delivered on [...] the Chairman, Lord Henry Lennox, on th[e ...] November, 1871, appears a statement to t[he effect] that the Council were of opinion that the [time had] arrived when public opinion would justify [their] taking active measures for promoting t[he estab]lishment of a National Training School f[or Music.] It then goes on to suggest that the schoo[l should] be established in connection with the All[bert Hall,] and expresses a hope that the Commis[sioners of] 1851 would supply the funds. In [...] Musical Education Committee of th[e Society] was joined by H.R.H. the Duke of E[dinburgh,] and in 1873 a meeting of this Comm[ittee was] held at Clarence-house, with his Roy[al High]ness in the chair. At this meeting [it was] stated that the Corporation of th[e] Albert Hall was willing to supply accom[modation] for students, and that application had b[een made] to the Commissioners of 1851 for a plot [of ground] on the western side of the hall. He a[dded that] the Royal Academy of Music "was not [an institu]tion in which the Society could avail its[elf of the] services of that body." His Royal [Highness] expressed his regret that the Royal [Academy] could not be made the basis for the [National] Training School. Eventually, it was re[solved] "That it is desirable to erect a building[, at a cost] not exceeding £20,000, for the purp[ose of a] Training School for Music at Kensingto[n, in con]nection with the Society of Arts." "Th[at a Sub-]Committee be appointed to consider on w[hat terms] and on what conditions that sum may [be raised,] in shares or otherwise, and that such Sub-C[ommittee] consist of the Duke of Edinburgh, Mr [...] Mr. Freake, Major Donnelly, and Mr. C[ole]."

4. This Sub-Committee prepared a rep[ort, which] was submitted to the General Comm[ittee, and] afterwards to the Council. It states [that the] Society of Arts had decided "to take the [initiative] and establish a Training School, by volunt[ary effort,] with the full intention and confident ho[pe that it] will eventually be transferred to the r[esponsible] management of the State." It proposed t[o found] about 300 free scholarships. These we[re of] two kinds—one affording free instruction, [the other] free instruction and maintenance. It w[as stated] that should there be more accommodat[ion in the] school than was requisite for the instr[uction of] the free scholars; students paying t[heir own] fees would be admitted by competiti[on to the] vacancies, "care being taken that t[hey have] sufficient aptitude." Some propositions w[ere ...]

* Report of Society of Arts Committee on Musical Education. 1866, Price 5s.

* See also Sixth Report of H.M. Commissioners [for the] Exhibition, Appendix O, p. 99.

arrangements for the purchase of land erection of a building; but as these were ed out eventually, it seems needless to re-em. The last paragraph of this report ran ws:—"Lastly, it is proposed that the hall be commenced as soon as possible, Committee of Management, consisting of mbers appointed by the Royal Commis-for the Exhibition of 1851, two members ed by the Council of the Royal Albert nd three members appointed by the Council ociety of Arts." The Sub-Committee were ed to prepare plans and estimates.

is not, perhaps, necessary to refer in detail way in which preparations were made foundation of the school. It may be suffi-say that eventually Mr. Charles J. Freake k to erect the school at his own cost. This announced by the Prince of Wales at a of the promoters, held at Marlborough-the 9th of July, 1875. The Commissioners rovided the site, near the Albert Hall, arge, and the corporation of the Albert rtook to lend certain of the rooms, and a the Hall, for the use of the students. th of December, 1873, the first stone of ng was laid by H.R.H. the Duke of a. This event was celebrated by a con-Albert Hall, at which his Royal High-e. After referring briefly to the early the negociations, he said, "There was a he labours of the Society of Arts, and urs have now extended over about 15 : there was another pause, which occurred a suggestion, on account of a thought on hat the two institutions might have been o one. I myself undertook negociations Royal Academy of Music with that view; some considerable time had been spent re found that the principles on which the tions were founded were so far apart, as not advisable that they should be o one. The Royal Academy has but few rships for those who have displayed a e and aptitude, but have not means; the tal principle of the school we are assem-vening to celebrate the foundation of, is holarships for all ranks of society."

school was opened, in 1876, with 82 free ps, of which four were founded by the Arts, two by members of the Society of by Mrs. Freake, ten by the Corporation n, fourteen by some of the City Guilds, ee by provincial towns, nearly all of re obtained through the agency of the Arts, the money for the purpose being the understanding that, so soon as the ould be able to afford it, the cost of these scholarships should be refunded iety.*

objects for which this school was founded forth in the report above referred to, by the Musical Committee in 1873. This s issued as a draft prospectus for the that time, and the substance of it was in the first Directory issued by the school. ectory it was stated that "the funda-inciple and primary object of the school ivation of the highest musical aptitude in the country, in whatever station of society it may be found. In order to carry out this principle to the fullest extent, admission to the school will be obtained by competitive examination alone. A Training School for Music founded thus, on the basis of free instruction, given only to successful competitors in public examinations, occupies a field of action wholly distinct from that of any existing institution."

8. The amount spent previous to the foundation of the National Training School for Music, by the Musical Educational Committee, was £217. Since the foundation of the school, in 1873, there has been spent £956, exclusive of the Society's Scholarships, which amount to £800. The Society has also held examinations in Music since 1859, in connection with its general system of examinations. The charges of these cannot well be separated from the General Examination charges. The fees for the Examiners in Music, however, amount to £214, while £194 have been paid for prizes. The total amount which the Society may be said to have expended upon Musical Education, and the National Training School for Music, is £2,382, of which £1,756 have been spent directly upon the school, during the past seven years.

* See Minutes of Council, 19th May, 1874.

MISCELLANEOUS.

ROSE OIL, OR OTTO OF ROSES.

By Charles G. Warnford Lock.

This celebrated perfume is the volatile essential oil distilled from the flowers of some varieties of rose. The botany of roses appears to be in a transition and somewhat unsatisfactory state. Thus the otto-yielding rose is variously styled *Rosa damascena*, *R. sempervirens*, *R. moschata*, *R. gallica*, *R. centifolia*, *R. provincialis*. It is pretty generally agreed that the kind grown for its otto in Bulgaria in the damask rose (*R. damascena*), a variety induced by long cultivation, as it is not to be found wild. It forms a bush, usually 3 to 4 feet, but sometimes 6 feet high; its flowers are of moderate size, semi-double, and arranged several on a branch, though not in clusters or bunches. In colour, they are mostly light-red; some few are white, and said to be less productive of otto.

The utilisation of the delicious perfume of the rose was attempted, with more or less success, long prior to the comparatively modern process of distilling its essential oil. The early methods chiefly in vogue were the distillation of rose-water, and the infusion of roses in olive oil, the latter flourishing in Europe generally down to the last century, and surviving at the present day in the South of France. The butyraceous oil produced by the distillation of roses for making rose-water in this country is valueless as a perfume; and the real otto was scarcely known in British commerce before the present century.

The profitable cultivation of roses for the preparation of otto is limited chiefly by climatic conditions. The odoriferous constituent of the otto is a liquid containing oxygen, the solid hydrocarbon or stearoptene, with which it is combined, being absolutely devoid of perfume. The proportion which this inodorous solid constituent bears to the liquid perfume in-

creases with the unsuitability of the climate, varying from about 18 per cent. in Bulgarian oil, to 35, and even 68 per cent. in rose oils distilled in France and England. This increase in the proportion of stearoptene is also shown by the progressively heightened fusing-point of rose oils from different sources: thus, while Bulgarian oil fuses at about 61° to 64° Fahr., an Indian sample required 68° Fahr.; one from the South of France, 70° to 73° Fahr.; one from Paris, 84° Fahr.; and one obtained in making rose-water in London, 86° to 89½° Fahr. Even in the Bulgarian oil, a notable difference is observed between that produced on the hills, and that from the lowlands.

It is, therefore, not surprising that the culture of roses, and extraction of their perfume, should have originated in the East. Persia produced rose-water at an early date, and the town of Nisibin, north-west of Mosul, was famous for it in the 14th century. Shiraz, in the 17th century, prepared both rose-water and otto, for export to other parts of Persia, as well as all over India. The Perso-Indian trade in rose oil, which continued to possess considerable importance in the third quarter of the 18th century, is declining, and has nearly disappeared; but the shipments of rose-water still maintain a respectable figure. The value, in rupees, of the exports of rose-water from Bushire in 1879, were—4,000 to India, 1,500 to Java, 200 to Aden and the Red Sea, 1,000 to Muscat and Dependencies, 200 to Arab coast of Persian Gulf, and Bahrein, 200 to Persian coast and Mekran, and 1,000 to Zanzibar. Similar statistics relating to Lingah, in the same year, show—Otto: 400 to Arab coast of Persian Gulf, and Bahrein; and 250 to Persian coast and Mekran. And Bahrein — Persian Otto: 2,200 to Koweit, Busrah, and Bagdad; rose-water: 200 to Arab coast of Persian Gulf, and 1,000 to Koweit, Busrah, and Bagdad.

India itself has a considerable area devoted to rose-gardens, as at Ghazipur, Lahore, Amritzur, and other places, the kind of rose being *R. damascena*, according to Brandis. Both rose-water and otto are produced. The flowers are distilled with double their weight of water in clay stills; the rose-water (*goolabi pani*) thus obtained is placed in shallow vessels, covered with moist muslin to keep out dust and flies, and exposed all night to the cool air, or fanned. In the morning, the film of oil, which has collected on the top, is skimmed off by a feather, and transferred to a small phial. This is repeated for several nights, till almost the whole of the oil has separated. The quantity of the product varies much, and three different authorities give the following figures:—(*a*) 20,000 roses to make 1 rupee's weight (176 gr.) of otto; (*b*) 200,000 to make the same weight; (*c*) 1,000 roses afford less than 2 gr. of otto. The colour ranges from green to bright-amber, and reddish. The oil (otto) is most carefully bottled; the receptacles are hermetically sealed with wax, and exposed to the full glare of the sun for several days. Rose-water deprived of otto is esteemed much inferior to that which has not been so treated. When bottled, it is also exposed to the sun for a fortnight at least.

The Mediterranean countries of Africa enter but feebly into this industry, and it is a little remarkable that the French have not cultivated it in Algeria. Egypt's demand for rose-water and rose-vinegar is supplied from Medinet Fayum, south-west of Cairo. Tunis has also some local reputation for similar products. Von Maltzan says that the rose there grown for otto is the dog-rose (*R. canina*), and that it is extremely fragrant, 20 lbs. of the flowers yielding about 1 dr. of otto. Genoa occasionally imports a little of this product, which is of excellent quality. In the south of France, rose gardens occupy a large share of attention, about Grasse, Cannes, and Nice; they chiefly produce rose-water, much of which is exported to England. The essence (otto) obtained by the distillation of the Provence rose (*R. provincialis*) has a characteristic perfume, arising, it is believed, from the bees transporting the pollen of the orange flowers into the petals of the roses. T[…] otto is richer in stearoptene than the […] nine grammes crystallising in a litre (1¾ pint) at the same temperature as 18 grammes of th[…] The best preparations are made at Cannes a[…] The flowers are not there treated for the ott[…] submitted to a process of maceration in fat[…] kilos. of roses being required to impregnate a[…] fat. The price of the roses varies from 50 […] 25 c. per kilo.

But the one commercially important source [of] roses is a circumscribed patch of ancient […] modern Bulgaria, stretching along the south […] of the central Balkans, and approximately between the 25th and 26th degrees of east […] and the 42nd and 43rd degrees of north latitu[de…] chief rose-growing districts are Philippopli, Giopcu, Karadshah-Dagh, Kojun-Tepe, […] Jeni-Sara, Bazardshik, and the centre and he[…] of the industry, Kazanlik (Kisanlik), situ[…] beautiful undulating plain, in the valley of t[…] The productiveness of the last-mentioned di[…] be judged from the fact that, of the 123 localities carrying on the preparation of otto […] they numbered 140 in 1859—42 belong to it. […] place affording otto on the northern side of t[…] is Travina. The geological formation thr[…] syenite, the decomposition of which has pro[…] so fertile as to need but little manuring. T[…] tion, according to Baur, indicates a clima[…] but slightly from that of the Black Forest, t[…] summer temperatures being stated at 82° Fa[…] and 68° Fahr. in the evening. The rose-bus[…] best and live longest on sandy, sun-exposed […] south-east aspect) slopes. The flowers produ[…] growing on inclined ground are dearer a[…] teemed than any raised on level land, being […] richer in oil, and that of a stronger qu[…] proves the advantage of thorough drainag[…] other hand, plantations at high altitudes yie[…] which is of a character that readily congea[…] insufficiency of summer heat. The districts […] jacent to and in the mountains are sometime[…] hard frosts, which destroy or greatly reduc[…] Floods also occasionally do considerable da[…] bushes are attacked at intervals and in pa[…] blight similar to that which injures the […] country.

The bushes are planted in hedge-like rows […] and fields, at convenient distances apart, for […] ing of the crop. They are seldom man[…] planting takes place in spring and autumn; […] attain perfection in April and May, and the […] from May till the beginning of June. Th[…] flowers are gathered before sunrise, often wi[…] attached; such as are not required for im[…] tillation are spread out in cellars, but all […] within the day on which they are plucked. […] that, if the buds develop slowly, by rea[…] damp weather, and are not much exposed t[…] when about to be collected, a rich yield of o[…] a low solidifying point, is the result, wherea[…] sky be clear and the temperature high at or […] fore the time of gathering, the product is […] and is more easily congealable. Hanbury, […] trary, when distilling roses in London, […] when they had been collected on fine dry da[…] water had most volatile oil floating upon it […] when gathered in cool rainy weather, little o[…] oil separated.

The flowers are not salted, nor s[…] any other treatment, before being conveyed on the heads of men and women, and animals, to the distilling apparatus. T[…] of a tinned-copper still, erected on a s[…] bricks, and heated by a wood fire; from th[…] a straight tin pipe, which obliquely tra[…]

ntly filled with cold water, by a spout, from nient rivulet, and constitutes the condenser. :h stills are usually placed together, often : shade of a large tree. The still is charged 50 lbs. of roses, not previously deprived of es, and double the volume of spring water. ation is carried on for about 1½ hour, the g simply a very oily rose-water (*ghyul-suyu*). sted flowers are removed from the still, and on is used for the next distillation, instead of r. The first distillates from each apparatus and distilled by themselves, one-sixth being ; the residue replaces spring water for sub-lations. The distillate is received in long-tles, holding about 1½ gallon. It is kept in a day or two, at a temperature exceeding by which time, most of the oil, fluid and have reached the surface. It is skimmed off long-handled, fine-orificed tin funnel, and is for sale. The last-run rose-water is extremely and is much prized locally for culinary al purposes. The quantity and quality of : much influenced by the character of the n distilling. When hard spring water is the otto is rich in stearoptene, but less and fragrant. The average quantity of is estimated by Baur at 0·037 to 0·040 per ier authority says that 3,200 kilos. of roses of oil.

. carefully distilled, is at first colourless, becomes yellowish; its specific gravity is Fahr.; its boiling-point is 444° Fahr.; it !·8° to 60·8° Fahr., or still higher; it is soluble lcohol, and in acetic acid. The most usual tests of the quality of an otto are (1) its s congealing point, (3) its crystallisation. in be judged only after long experience. should congeal well in five minutes at a of 54·5° Fahr.; fraudulent additions ongealing point. The crystals of rose-.re light, feathery, shining plates, filling uid. Almost the only material used for ieightening the apparent proportion of is said to be spermaceti, which is easily from its liability to settle down in a solid om its melting at 122° Fahr., whereas uses at 91·4° Fahr. Possibly paraffin wax easily escape detection.

rations by means of other essential oils are difficult of discovery, and much more 'act, it is said that none of the Bulgarian letely free from this kind of sophisti-e oils employed for the purpose are e grass oils (*Andropogon* and *Cymbopogon* r that afforded by *Andropogon*, *Schœnanthus* ighi by the Turks, and commonly known to s "geranium oil," though quite distinct eranium oil. The addition is generally rinkling it upon the rose-leaves before t is largely produced in the neighbourhood . exported to Turkey by way of Arabia; it rabs in Constantinople in large bladder-d-copper vessels, holding about 120 lbs. ly itself adulterated with some fatty oil, it lergo purification before use. This is he following manner:—The crude oil is aken up with water acidulated with lemon-hich it is poured off after standing for a ashed oil is placed in shallow saucers, well n and air, by which it gradually loses its odour. Spring and early summer are the for the operation, which occupies two to ecording to the state of the weather and f the oil. The general characters of this ailar to those of otto of roses—even the g a distant resemblance—that their dis-then mixed is a matter of practical impossibility. The ratio of the adulteration varies from a small figure up to 80 or 90 per cent. The only safeguard against deception is to pay a fair price, and to deal with firms of good repute, such as Messrs. Papasoglu, Manoglu and Son, Ihmsen and Co., and Holstein and Co., in Constantinople.

The otto is put up in squat-shaped flasks of tinned copper, called *kunkumas*, holding from 1 to 10 lb., and sewn up in white woollen cloths. Usually their contents are transferred at Constantinople into small gilded bottles of German manufacture for export. The Bulgarian otto harvest, during the five years 1867-71, was reckoned to average somewhat below 400,000 *meticals*, *miskals*, or *midkals* (of about 3 dwt. troy), or 4,226 lb. av.; that of 1873, which was good, was estimated at 500,000, value about 700,000*l*. The harvest of 1880 realised more than 1,000,000*l*., though the roses themselves were not so valuable as in 1876. About 300,000 *meticals* of otto, valued at 932,077*l*., were exported in 1876 from Phillipopolis, chiefly to France, Australia, America, and Germany.

PROVINCE OF ASTERABAD AND ITS INHABITANTS.

Asterabad is situated in the south-east corner of the Caspian Sea; its inhabitants do not exceed 45,000, and the town of Asterabad can only boast of 8,000 souls. It is bounded on the south by the high range of mountains which separate the Persian Caspian provinces from the other parts of Persia. On the north it is bounded by the Atrek as far as Chat, situated at the confluence of the Sombar and the Atrek; beyond that point it is doubtful where the boundary lies in that direction. The west is bounded by the Caspian Sea and the province of Mazanderan, and in the east it is adjoining to the province of Meshed. Gez, Molla. Kellè, and Gumush Tèpè are the only ports in the province in use. The former is in weekly communication with the other ports of the Caspian by means of the Mercury and Kafkas steamers, and although but a small village of 150 houses, it is the emporium of all the trade carried on between the civilised world and north-east Persia. English manufactures, French sugar, and Russian hardware find their way through Gez to Meshed and Herat, while Yezd opium, Meshed carpets, Sebzewar silkworm eggs, Damghan lead, Asterabad cotton and wheat find an outlet through Gez. The province of Asterabad is well wooded, and is watered by numerous mountain streams. The principal districts are those of Anazan, Sedem, Rustak, Asterabad Rustak, Katoul, Finderisk, Shahkou, and Salwar. The inhabitants of Asterabad mostly belong to the Kajar tribe, of which the Shah of Persia is the chief; members of the Tat tribes are also to be met with. As head of the Kajars, the Shah possesses considerable estates in the province, which are farmed out to various individuals, giving a rental of £7,700. The fertility of the soil, wherever it has been cleared of the overhanging forest, is wonderful, producing as much as from 60 to 120 bushels for one bushel sown. The timber in the forests is magnificent, and in any other country it would form a source of great riches, but over the whole extent of the province there is not a single road worthy of that name, and the traffic that penetrates into the interior has to wend its way on horseback through the forests and through the rice fields.

Parallel with the Elboorz, and at a distance of 20 miles to the north, runs the river Gurgan, about 60 miles long. Fifteen miles or so north of the Gurgan is the Atrek. Between these two rivers is to be found the most fertile soil that can possibly be imagined, and it is on this strip of land that the Turkomans pitch their obehs; the Yemoots between the sea shore and Gombuz-i-Kabous, 60 miles inland; and the Goklans between this point and Kari-Kaleh. The Yemoot tribe of

Turkomans number about 80,000 families, of which, however, only about 20,000 have anything to do with Persia. They are sub-divided into two distinct tribes, named, respectively, Jaaferbai or Sherif, and Attabai, or Chuni. The Jaaferbai Turkomans comprise two grand divisions—the Yar Alis, and the Noor Alis, each having various sub-divisions of its own. The Attabai Turkomans have also two grand divisions—the Attabai proper, and the Ak. Each of these divisions comprise two classes of Turkomans, called respectively, Charvai, and Chumour, that is to say the rich or noble class, which can afford to move about from place to place, and the poorer class, called Chumour, whose means do not enable them to move away from the banks of the Gurgan. The Charvai are in the habit of moving towards the north, as far as the Balkan mountains, near Krasnavodsk, twice a year. When the harvest is ripe, these nomads return to the Gurgan. The Chumour are the people, generally speaking, who are addicted to man stealing. The amount of tribute paid by the Yemoot Turkomans to the Persian Treasury is 2,000 tomans; it is collected both in money and kind, such as carpets and felts. Advantage is frequently taken by the Persian authorities, of any discord reigning among the Turkomans themselves to increase the amount of taxation, and the Turkomans seize the first opportunity to recoup themselves on the villagers of Asterabad. The Goklans were formally 12,000 families, but owing to the constant attacks made upon them by their Persian neighbours, the Saad-el-Loo Kurds of Boojnoord, they have now been reduced to 4,000. They inhabit the rich plains, situated on either side of the Gurgan, east of Gombuz-i-Kabous. The amount of tribute paid by the Goklans to the Treasury is 6,000 tomans, which is collected by Yar Mohammed Khan, of Boojnoord, and handed over to the Government of Asterabad.

Besides the regular caravans, a large number of pilgrims pass through the province of Asterabad every year from the western shores of the Caspian Sea, proceeding to the Holy Shrine of Reza, the seventh Imaum of the Shias, whose tomb is in the city of Meshed, in Khorassan, and to defray the expenses of the journey, the pilgrims usually carry with them small parcels of merchandise; by this means the produce and industry of Russia and the Caucasus, and even of Western Europe, finds its way up to the confines of Afghanistan, while the produce of Central Asia, in the shape of carpets, coarse cloth, felt, lamb skins, dried fruit, and precious stones, finds its way to the markets of Western Asia and Constantinople.

CINCHONA BARK FROM JAMAICA.

A large consignment of Cinchona bark from Jamaica has, during the past few months, found its way into the London market, where it has met with a ready sale, and at prices far in advance of those realised for Ceylon and East Indian bark. The results of the Jamaica Cinchona sales for the year 1879-80, have, according to the report of the Director of Public Gardens and Plantations, slightly exceeded the estimated returns, and are as follows:—Quantity of bark shipped, 27,399 lbs.; gross amount realised, £5,380 9s. 6d., nett sum realised, £5,146 8s. 7d. It is shown in the report just referred to, that crown bark realises the highest price, and the greater value of this being established as against red bark, it is found desirable to plant the red bark only at elevations (2,500 to 4,000 feet) where the crown bark will not grow. The latter, however, may be cultivated in Jamaica over thousands of acres on the Blue Mountain slopes, on all elevations above 4,000 feet. The following quotations of prices will show the comparison between Ceylon and Jamaica barks. For red bark "fine quill," from Ceylon, reached a maximum of 4s. 3d. per lb., as against 4s., for "fair quill," from Jamaica. For "red root bark," the highest Jamaica produce was 4s. 8d. per lb., for "goo[d] as against 2s. 6d. for "good root," from Cey[lon] showing an advantage in favour of Jamaica [r] to the extent of 2s. 2d. per lb. For "twig [a] ordinary" bark of *Cinchona succirubra*, Ceylon obtained from 2½d. to 1s. per lb. as against 1s. 6d. per lb. for similar bark from Jamaica. "T[his] will, it is hoped, show that as with the celebra[ted] Mountain coffee of Jamaica, so with the Cinch[ona] grown in the same region, the conditions of climate appear to be eminently favourable to [pro]duction of the best qualities of these valuable [p] and as large tracts of land and the necessary la[bour] now available, there are only wanting sufficie[nt] and energy to overcome the initial difficulti[es] enterprise."

Accompanying the report from whence the extracted are a series of instructions under th[e] "Hints and suggestions for raising Cinchon[a] from seed and establishing Cinchona plantatio[ns]

CORRESPONDENCE.

MACTEAR'S MECHANICAL FURNAC[E] CONTINUOUS SYSTEM OF MANUFAC[TURING] SULPHATE OF SODA.

Referring to the report of Mr. Mactear's pape[r] cussion thereon in the *Journal* of February 4, 18[81] our patents having been alluded to in a very dis[paraging] manner, we rely upon your sense of fairness in ting a few brief corrections to go forth to you[r] through the same medium, viz.:—

1. We beg to point out that our first patent is not restricted to any particular form of a[pparatus] but covers the principle of conducting the ca[lcination] and decomposition in the same vessel by m[echanical] means.

2. In this patent Mr. Mactear sees not[hing] "failure." As a matter of fact, although no[w super]seded by our improved pattern of 1880 date, [f]rom 25 to 30 furnaces, on the original plan, i[n] operation, the returns from which continue to factory.

3. Mr. Mactear states that the "greatest obj[ection] all to the system adopted by Jones and W[alsh] which holds good equally with the new form of is that the salt and acid, being all added withi[n a com]paratively small period of time, there is a gre[at evolu]tion of muriatic acid gas at the beginning of t[he opera]tion, and a rapidly decreasing amount as th[e process] continues." This objection is purely theore[tical. In] practice, it is found that with proper co[ndensing] arrangements, there is no difficulty whatever [in] condensation, the fact being, as stated by Mr. [C...] that more hydrochloric acid, and of a higher [strength,] is obtained from our patent furnace than [from] ordinary hand furnaces.

4. There is nothing new in the "continuous [system"] adopted by Mr. Mactear. At the suggestio[n of Mr.] Hugh Lee Pattinson, of Newcastle, it was trie[d at our] works in 1876; the apparatus for the purp[ose, a] "screw operated by a ratchet wheel," pre[cisely as] described by Mr. Mactear, and was provision[ally pro]tected by the engineer who made it. It [was] abandoned, but the apparatus is in our hands [.]

5. We deny that our rotating furnace (pat[ent ...]) is in any respect an "imitation" of Mactear's [rota]ting furnace. It was merely a return to ou[r] plan, tried in 1875, of which we have the m[...] The principle of a rotating pan is old, much ol[der than] either Mr. Mactear's or our own ideas on the s[ubject.]

Jones & [W...]

[ ]TIONS FOR PREVENTING LONDON SMOKE.

[ ]cond sentence of Mr. J. A. C. Hay's letter, [ ] beg to be allowed to refute the statements [ ] Scott-Moncrieff's) paper, in so far as they [ ] Royal Arsenal or any other of the Govern[ ]works." He then proceeds to confirm my [ ] in every detail and particular. I alleged [ ]in difficulties, the manager of the gas works [ ]h Arsenal had used a short extraction. Mr. [ ]ms this statement. I alleged that the fuel [ ]as superior. Mr. Hay confirms this by [ ]t the coal they used was volatile cannel, and [ ]ng extraction "it contained very little heat[ ]ies, and was not used under the retorts." [ ]ay mean to say the fuel was worse under a [ ]tion than a long one? If so, he contradicts [ ]nt made to me by Mr. Wallace, who said it better. Does Mr. Hay mean to deny that [ ]gas comes off during the first two or [ ]s? Does he deny that it comes off [ ]lly during that period? In short, does [ ]leny what he himself confirms, by his [ ]ccasionally," and "in order to meet a few emergencies," adopted the scheme which I [ ]n my paper? He speaks of the plan having [ ]d to be very expensive and uneconomical," Hay did not carry it out with sufficient in[ ]his is hardly to be wondered at.

[ ]ard to Mr. Hay's postscript, as to whether [ ]e did or did not supply me with the facts, this [ ]of personal veracity. I certainly understood [ ] the facts precisely as I stated them in my [ ]ding any conclusions which I drew from [ ]s impression is confirmed by Mr. Hay's what has been going on at the Arsenal. I [ ]naware of any official relations between Mr. [ ]d Mr. Hay, nor, indeed, am I now aware relations are.

W. D. SCOTT-MONCRIEFF.

WOOD-CARVING.

[ ]erence to the discussion which took place last [ ]ink it ought to be stated that the School of [ ]ing at the Royal Albert-hall derives its [ ]pport from some of the City Companies, and [ ]e Science and Art Department, as some of [ ]e seemed to imagine. I hope it will do good [ ]he trade, as well as to the public.

J. H. POLLEN.

[ ]ge-crescent, W., Feb. 10, 1881.

GENERAL NOTES.

[ ] Art Wood-carving.—This school is now in [ ]with the City of Guilds of London Technical [ ] It is under the direction of a committee of [ ], of which Lieut.-Colonel J. F. D. Donnelly, [ ]airman. Day and evening classes are held in [ ] The day classes are held from 10 to 5 on five [ ], and from 10 to 1 on Saturdays. The evening [ ]held from 7 to 9 on four evenings a week, viz., [ ]esday, Thursday, and Friday. The fees for [ ]s are £2 a month, or £5 a quarter. The fees for [ ]dents are 15s. a month, or £2 a quarter. There [ ]at 12 free studentships in the school, viz., six in [ ]and six in the evening classes, the fees for which [ ]om funds supplied by the City and Guilds of [ ]tute for the advancement of technical education. [ ] of the studentships are selected by the committee of the school from persons of the industrial class, who are intending to earn their living by wood-carving. Candidates must have passed the 2nd grade art examination of the Science and Art Department in freehand drawing at least. Those who have some knowledge of wood-carving, or have passed in the other subjects of the 2nd grade art certificate, or in drawing from the antique and the figure, architectural drawing, or designing, or in modelling, will be preferred. There are now several vacant studentships, and there is also available accommodation for a few additional paying students. Students who have been in the school not less than twelve months may, on the recommendation of the inspector, receive such payment for their work as the committee may determine. By permission of the Lord President of the Council, students of the school have the privilege of free admission to the South Kensington Museum and libraries, on production of their school tickets. Wood-carving for the trade is undertaken by the school. For further information on all the above points, applications should be addressed to the secretary at the school.

Domestic Sanitation.—Dr. Richardson's course of nine lectures, to be delivered before the Ladies' Sanitary Association, in the Hall of the Society of Arts, will commence on Saturday, 12th inst., at 5.30 p.m., and be continued on successive Saturdays, until April 9. Tickets admitting to reserved seats, one guinea for the course, or 3s. 6d. for each lecture, can be obtained at the office of the Association, 22, Berners-street, W., or at the Society of Arts. Admission to unreserved sittings, 1s.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock:—

FEBRUARY 16.—"The Participation of Labour in the Profits of Enterprise." By SEDLEY TAYLOR, M.A., late Fellow of Trinity College, Cambridge. W. H. HALL will preside.

FEBRUARY 23.—

MARCH 2.—"On Lighthouse Characteristics." By Sir WILLIAM THOMSON, LL.D., F.R.S. F. J. BRAMWELL, F.R.S., Chairman of Council, will preside.

MARCH 9.—

MARCH 16.—"Buying and Selling; its Nature and its Tools." By Prof. BONAMY PRICE, M.A. Lord ALFRED S. CHURCHILL will preside.

MARCH 23.—"The Increasing Number of Deaths from Explosions, with an Examination of the Causes." By CORNELIUS WALFORD.

MARCH 30.—"Recent Advances in Electric Lighting." By W. H. PREECE.

APRIL 6.—"The Manufacture of Glass for Decorative Purposes." By H. J. POWELL (Whitefriars Glass Works).

FOREIGN AND COLONIAL SECTION.

Tuesday evenings, at eight o'clock:—

FEBRUARY 22.—"The Languages of South Africa." By ROBERT N. CUST.

MARCH 15.—"The Loo Choo Islands." By Consul JOHN A. GUBBINS. Sir RUTHERFORD ALCOCK, K.C.B., will preside.

APRIL 5.—"Trade Relations between Great Britain and her Dependencies." By WILLIAM WESTGARTH.

APPLIED CHEMISTRY AND PHYSICS SECTION.

Thursday evenings, at eight o'clock:—

FEBRUARY 24.—"Deep Sea Investigation, and the Apparatus used in it." By J. G. BUCHANAN, F.R.S.E., F.C.S. Captain Sir GEORGE S. NARES, R.N., K.C.B., F.R.S., will preside.

MARCH 24.—"The Future Development of Electrical Appliances." By Prof. JOHN PERRY.

The meeting previously announced for April 7 will be held on May 12.

INDIAN SECTION.

Friday evenings, at eight o'clock:—

FEBRUARY 11.—"Gold in India." By HYDE CLARKE. Sir WILLIAM ROBINSON, K.C.S.I., will preside.

MARCH 4.—"The Results of British Rule in India." By J. M. MACLEAN.

MARCH 25.—"The Tenure and Cultivation of Land in India." By Sir GEORGE CAMPBELL, K.C.S.I., M.P.

MAY 13.—"Burmah." By General Sir ARTHUR PHAYRE, G.C.M.G., K.C.S.I., C.B.

Members are requested to notice that it may be necessary to make alterations in the dates of the above papers.

CANTOR LECTURES.

Monday evenings, at eight o'clock:—

The Second Course will be on "Watchmaking," by EDWARD RIGG, M.A. Three Lectures.

Syllabus of the Course.

LECTURE II.—FEBRUARY 14.

The ordinary watch—Degree of accuracy required in it—Systems of manufacture in this country and abroad —Description of specimens illustrative of the various stages of construction—Comparison of the several systems.

LECTURE III.—FEBRUARY 21.

Necessity of efforts to promote the art in this country —Need of education, theoretical and practical, in horology—Literature—Great want of uniformity in gauges, screws, &c.—Exhibition of ordinary and complicated watches, and of watchmakers' tools—Conclusion.

The Lectures will be illustrated by Specimens, Models, and Diagrams. The different movements, &c., will be shown enlarged on the screen by means of the Aphengiscope and the Electric Light.

The Third Course will be on "The Scientific Principles involved in Electric Lighting," by Prof. W. G. ADAMS, F.R.S. Four Lectures.

March 7, 14, 21, 28.

The Fourth Course will be on "The Art of Lace-making," by ALAN S. COLE. Three Lectures.

April 25; May 2, 9.

The Fifth Course will be on "Colour Blindness and its Influence upon Various Industries," by R. BRUDENELL CARTER, F.R.C.S. Three Lectures.

May 16, 23, 30.

ADMISSION TO MEETINGS.

Members have the right of attending all the Society's meetings and lectures. Every Member can admit *two* friends to the Ordinary and Sectional Meetings, and *one* friend to the Cantor Lectures. Books of tickets for the purpose have been issued to the Members, but admission can also be obtained *on the personal* introduction of a Member.

MEETINGS FOR THE ENSUING WE

MONDAY, FEB. 14TH...**SOCIETY OF ARTS,** Adelphi, W.C., 8 p.m. (Cantor Lectures.) Rigg, "Watchmaking." (Lecture II.)
Royal Institution, Albemarle-street, W., 3 Hueffer, "The Troubadours." (Lecture
Royal Geographical, University of London, gardens, W., 8½ p.m. Mr. William M. Cr graphical and Physical Aspects of Sarawa Borneo."
British Architects, 9, Conduit-street, W., journed Discussion on Mr. E. C. Robins' p tary Science in its Relation to Civil Archit
Medical, 11, Chandos-street, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., John Lubbock, "Fruit and Seeds."

TUESDAY, FEB. 15TH...Royal Institution, Albemarle- p.m. Prof. E. A. Schäfer, "The Blood."
Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion upon the pape Colson and Meyer, "The Portsmouth Doc sion Works."
Statistical, Somerset-house-terrace, Strand,
Pathological, 53, Berners-street, Oxford-stree
Zoological, 11, Hanover-square, W., 8½ p Secretary, "Additions to the Society's Men the Month of January, 1881." 2. Mr. (house, "The Coleopterous Insects Belo Family *Hispidæ*, collected by Mr. Buckley 3. Mr. W. L. Distant, "Additions to th Fauna of the Ethiopian Region." 4. M Smith, "A Collection of Shells from Lake and Nyassa and Other Localities in East A

WEDNESDAY, FEB. 16TH...**SOCIETY OF ARTS,** Adelphi, W.C., 8 p.m. Mr. Sedley Taylo ticipation of Labour in the Profits of Ente
Meteorological, 25, Great George-street, S 1. Mr. Charles Greaves, "Relative Humid William Marriott, "The Frost of Janua the British Isles."
Institute of Bankers (at the Theatre of the I tution, Finsbury-circus, E.C.), 6 p.m. Ellis, "The Clearing System Applied to Tr tribution."
Archæological Association, 32, Sackville-stre 1. Mr. F. Brent, "Prehistoric Interment a 2. Mr. C. Watkins, "Roman Wall of Londo ditch." 3. Mr. J. Romilly Allen, "N Grange."

THURSDAY, FEB. 17TH...Royal, Burlington-house, W
Antiquaries, Burlington-house, W., 8½ p.m.
Linnean, Burlington-house, W., 8 p.m. 1 Day, "British Fishes." 2. Mr. C. B. Cl and Left-hand Contortion of the Corolla." M. Duncan, "A New Form of Sponge." 4. G. Shattock, "The Reparative Processes w Vegetable Tissues."
Chemical, Burlington-house, W., 8 p.m. Election of Fellows. 2. Mr. D. Tomm Apparatus for showing the Dissociation of Salts." Mr. M. W. Williams, "The E Organic Carbon and Nitrogen in Wat simultaneously with the Estimation of Nit
London Institution, Finsbury-circus, E Rev. H. R. Haweis, "Violins."
Royal Institution, Albemarle-street, 9 p.m. "History of Drawing-room Music." (Lect Musical Illustrations.
Royal Historical, 22, Albemarle-street, W. Mr. Henry E. Malden, "The Battle of tween Ethelwulf and the Danes in A.D. Frederick G. Fleay, "The Connection bet and Allegory in certain Poems by Chaucer
Numismatic, 4, St. Martin's-place, W., 7 p.
Philosophical Club, Willis's-rooms, St. Ja 6½ p.m.
Civil and Mechanical Engineers, 7, Westmins S.W., 7 p.m. Mr. A. F. E. Grant, "W Strata of the Thames Basin."

FRIDAY, FEB. 18TH...Geological, Burlington-house Annual Meeting.
Royal United Service Institution, Whitehall Mr. E. Delmar Morgan, "His recent vis and on the Russo-Chinese Frontier."
Royal Institution, Albemarle-street, W., 3p. Lubbock, "Fruits and Seeds."
Philological, University College, W.C., 8 p Sweet, "Pronunciation of Welsh." (Part

SATURDAY, FEB. 19TH...Ladies' Sanitary Association (OF THE SOCIETY OF ARTS), 5.30 p.m. Dr. B son, "Domestic Sanitation or Health at H ture II.)
Royal Institution, Albemarle-street, W., 3 Stuart Poole, "Ancient Egypt in its Comp tions" (Lecture I.)

]NAL OF THE SOCIETY OF ARTS.

No. 1,474. Vol. XXIX.

FRIDAY, FEBRUARY 18, 1881.

...unications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

CANTOR LECTURES.

second lecture of the second course was red on Monday, 14th inst., by Edward Rigg, on "Watchmaking." The points to which ion was specially drawn, were the degree of cy required in the ordinary watch, the ı of manufacture in this country and abroad, comparison of the several systems. The ; was illustrated by the use of the aphengi- and the electric light, which enabled different of watches, and the works of several es (going and not going) to be reflected on a . The audience were thus able to see the object itself on an enlarged scale. Next it is intended to show the action of repeating :her watches in the same manner.

collection of specimens illustrative of the s stages of construction in the watch, which xhibited, will remain in the rooms of the y for a week, and can be seen by anyone sted in the subject, on presentation of his

lectures will be published in the *Journal* ; the summer vacation.

LABEL FOR PLANTS.

Council are prepared to award a Society's · Medal, together with a prize of £5, which ›en placed at their disposal for the purpose :. G. F. Wilson, F.R.S., for the best label for ι.

ı object of the offer is to obtain a label which ›e cheap and durable, and may show legibly ıver is written or printed thereon; the label be suitable for plants in open border. considerations will principally govern the ι.

cimen labels, bearing a number or motto, accompanied by a sealed envelope containing ıme of the sender, must be sent in to the ary not later than the 1st May, 1881.

The Council reserve to themselves the right of withholding the Medal and Prize offered, if, in the opinion of the judges, none of the specimens sent in are deserving.

ADJOURNMENT OF MEETING.

At the meeting of Wednesday, the 17th inst., the discussion on Mr. Sedley Taylor's paper, "The Participation of Labour in the Profits of Enterprise," was adjourned to Friday, the 25th inst., at 8 p.m. Cards already issued will be available for the adjourned meeting.

DOMESTIC ECONOMY.

1. The Council will hold a Third Congress on Domestic Economy, at the Society's Rooms in the Adelphi, London, during the present year.

2. The Council offer Seven Bronze Medals, and Certificates of Merit for Papers (not exceeding 1,000 words), written by Teachers of Public Elementary Schools and Training Colleges, which shall give an account of the best method practised by the teacher, of the teacher's experience, and the result of the teaching, in any one or more of the seven classes of subjects named below.

3. The Education Department, in the Code of 1880 (p. 31), classes the following subjects under Domestic Economy for Girls:—

The First Branch includes—

(a) Clothing and Washing.
(b) The Dwelling—Warming, Cleaning, and Ventilation.
(c) Rules for Health—The Management of the Sick Room, Cottage Income, Expenditure, and Savings.

The Second Branch includes—

(a) Food—Its Composition and its Nutritive Value
(b) Food—Its Functions.
(c) Food—Its Preparation and Culinary Treatment (*i.e.*, Practical Cookery) (§ 24).

The Council have resolved to add the subject of Needlework, which will be exhibited and discussed in the Congress, although it is not classed in the Code as a branch of Domestic Economy.

4. Only one medal will be given to a teacher, but the subjects taught successfully will be inscribed on the one medal and a certificate given.

5. The papers must be sent to the Secretary of the Society of Arts by the 1st May next. Each paper must be enclosed in a sealed envelope, bearing a motto, and must be accompanied by an envelope bearing the same motto, and having within it the writer's name and address.

6. No medals or certificates will be awarded if the papers are not of sufficient merit to deserve them.

INDIAN SECTION.

Friday, February 11, 1881; Sir William Rose Robinson, K.C.S.I., in the chair.

The paper read was—

GOLD IN INDIA.

By Hyde Clarke.

I. It was originally intended that this paper should have been read before a general meeting of the Society, in which case it might have been treated in considerable detail, for popular explanation. This, however, is not suited for the audience of the Indian Section, acquainted to a great extent with the subject, and whose attention has already been called to its bearings. If, however, the mode of treatment be altered, the importance of the subject is none the less, if it be not indeed greater. It is of much moment to all interested in India to determine what is the real character of the gold formations, and what effect they are likely to have on the country.

In so dealing with the matter in its general relations, there will be this advantage, that the possibility of promoting any individual speculation will be eliminated.

That there will be speculation, and wild speculation, in the new undertakings, there is not room for any doubt, but that is not to be taken into account in the serious consideration. It is not the casualties, not the extraneous circumstances, which are to be mainly regarded, but the really essential conditions.

There is a prevalent sentiment in Indian circles, that it is necessary to be cautious in dealing with the gold question. It is necessary to be cautious and to be prudent, but then the application of this principle has to be guarded. If it be considered desirable to avoid fallacious hopes, and to discourage undue excitement and gambling, it is none the less desirable, on the other side, to be cautious and to be prudent, so as not to impede or discourage the legitimate development of any resource of our Indian empire; particularly this, for gold is greater than indigo, than tea, than cinchona. This is a right side of prudence, for if we take a false step, then in this case, as in so many others, we shall throw back for years the advancement of the population. It was such hesitation which postponed the commencement of the railway system in India, and which has deprived the country, even to this day, of its full benefits, and such examples can be multiplied.

It appears to the public, that the discovery of gold in India is indeed one of the most remarkable events in this age, which has seen so many events materially affecting the destinies of the human race. The re-discovery of gold in California, and its discovery in Australia, greatly as they acted on the enterprise of the world, yet as the operations in connection with them took place in countries thinly peopled, they did not have the direct influence which must result from the development of gold mining amidst populations numbered by hundreds of millions.

In the same way as the existence of gold in India is regarded as a new fact, so is the extent of the formations regarded by many with doubt. It is beyond the power of any one to determine profitableness of the new workings, or the pre manner in which the condition of India will modified, but the careful observer cannot fai ascertain from history that the antecedent circu stances are such as to give importance to character of the present development. Thi what we have now to take into account, not act results, not possible loss, but the real gravit the explorations, so that we may neither ex gerate our expectations, nor neglect by carelessn what may be fairly esteemed to be of possi value to the empire.

The gold of India is traditional,* and yet, in days, gold had become scarce in those regio There is reason to think that the poetical lege of a golden age are not without foundation, that they refer to a time when the river sands the world and the alluvial formations were wor for this metal, which furnished the hoards of kings of old.† This golden age was followe the archæologists agree with the poets, by a bra or brazen age, and then came the iron indu giving name to the iron age.

Wherever we look we find that the rivers been cleared of the accessible gold, and we evidence of very old workings. India afford same testimony. In ancient times its countr must have been the richest, for, besides its wi area, it has numerous rivers, in most of which go is still found, but of such poor yield as to b scarcely worth working, even where the rates o wages are so nominally low.

There is scarcely a river in India but gives evi dence of the wide diffusion of gold, though th rise in wages has reduced the extent of loc working from what it was 40 or 50 years ago. I the Indus, between Attock and Kalabagh, as mu as 2,000 oz. yearly used formerly to be got. Go is found in the basin of the Ganges, in the Goomt the Ramgunga, and other rivers, particular those running at the foot of the Himalaya Hence many are now inclined to look wi interest on possible discoveries in those regio In Southern India, there can be little doubt th the known sites in the Wynaad and Mysore a only indications of larger formations. Riv washings are numerous in the Assam provinc and it has even been estimated that, at one tim the yield was near 40,000 oz.

While the numerous ancient workings a admitted as acknowledged evidence of form yield, yet they constitute with many a chi element of doubt, because it is considered t cessation of working is an indication of prese worthlessness.

Ancient workings are found in many parts the world, as in Spain largely, and in this countr to a more limited extent. Thus, we are able form some idea of the influences which ma interfere with operations. The interruptions a not necessarily dependent on failure of ore, f mines which have been abandoned for centuri

* On the possible connection of South India with Ophir of t Bible, see an interesting letter, by Mr. F. H. Crozier, in the Mad Journal. Mr. Samuel Jennings has dealt with the same subje but the reference has escaped me.

† See my book, "Khita and Khita-Peruvian." (Trübner an Co.).

‡ "Notes on the Distribution of Gold." James Wyld, Charin cross. Pp. 26 and 27.

resumed and kept in a state of production for g periods. Political and social events greatly ct these results. At former epochs mines were gely worked with convict or slave labour, and other times with serf labour.

A war, or an invasion, as that of the Mohamme-ms, would stop slave labour, and likewise affect e continuance of the skilled labour necessary for pervision. The stoppage of mining of itself constitutes an obstacle to resumption; so in the case f arable lands, the abandonment of cultivation brings its own evils and impediments. Wood covers the open country, and wild beasts find shelter, while the water-courses are interrupted, and marshes are formed, with fever as an attendant consequence. In abandoned mines, the shafts, pits, and galleries fall in, timber rots, and water accumulates. By and by the knowledge of the productive parts is forgotten, and workmen having left the district, the local traditions are lost.

Mines were, besides, worked by what has been here termed serf labour. The resident population were compelled to contribute labour for the mines, and those beyond to cut and transport wood for timbering and fuel, or to find carts and beasts to convey supplies and produce to and fro. Such military labour is compensated by nominal wages, remission of taxation, or by exemption from military service. If, however, the population is interfered with by civil or foreign war, or is re-sed from the strong hand of despotism, then whole system is relaxed, the technical training appears, there is an indisposition for mining ployment, and it becomes very difficult to ore the former regulations and restrictions.

ius in Asia Minor, for instance, the relatively silver and copper mines were kept working with ulty, and many were abandoned. The Tokat er mines and the silver mines of the Gumush ieh were kept going by exceptional richness, t length the Ottoman Government hesitated as e economical value of the traditional system. t was gained in copper and silver was con-ed to be lost in taxes and service, and the s have consequently been sold.

e condition of mining is generally artificial. public form their estimate from some places eptionally rich product, but mining generally usiness of poor and uncertain returns, as pre-as as the fisheries; many a mine in the world cost more than twenty shillings for its d's worth of produce. The operations are often d on as a gamble by those who contribute l, equally by those who contribute labour on or tribute. Whaling and sealing encounter ame vicissitudes. Not even agriculture is so y worked as such operations. Everything in hape of mineral is tried and raised at a loss, ut profit or with profit; a slight decline in et price will throw the poorest mines out of , and a small rise causes them to be opened. , differently from agriculture and from fish-the product of mining is put in abeyance, and aded even for many years, until a return of l or greater prosperity. The farmer goes on ing something in the famine years, but the stays his hand. He is always, to some de-migratory, and he can turn to other employ-t.

Thus, in a career of such vicissitudes, there are recurrent epochs, in which every shaft is fruitless, and the condition of the Indian gold mines is not exceptional. Their abandonment in no degree shows they cannot pay; it is no argument against their resumption, and none in favour. The value of the Indian mines must be determined by conditions altogether apart from such facts. The facts are in favour of the general existence of gold formations, and, considered in this light, they are of great importance, for they bear testimony to an extent of formations, illustrative of former enterprise, and inviting present consideration.

The condition of the old workings is very well described by a gentlemen of authority, Mr. Samuel Jennings, F.L.S., F.R.G.S.* He says, the native system consisted in the sinking of perpendicular shafts on the reefs and other workings around the base of the shaft, so long as it was safe, and working the alluvial deposits on the sides of the hills, so long as the dry weather continued; but as soon as the heavy rains of the season set in, work became impossible, and, as has happened recently, the rain has destroyed the excavations, by choking them up with the debris and earth that had been loosened, and the whole operation had to commenced again anew. Thus, in process of time, the entire surface, to the depth of 20 to 30 feet, was completely turned over, and all the precious metal extracted. The same state is found in the West African workings. The idea, says Mr. Jennings, of protecting their shafts by timbering, does not appear to have occurred to the native miners, whose powers of penetration seem to have been limited to the extent they were able to excavate in a single season.

In my opinion, there must, however, have been more able mining by the older races. An adit, 126 feet in length, on the Kintail estate, seen by Mr. Brough Smyth, is a type of this class. There must have been in ancient India the identical workings of the old miners, of which we have such fine specimens of Roman and earlier times in Spain and Britain.

Although gold production, under an energetic despot, may have been carried on with good results, a small despot or chief would not be equally successful in the attempt; on the contrary, he would find every obstacle. He would have to obtain assistance from without, and train workmen for the extraction and the reduction. Thus, it is not at all surprising that the recent representation of the ancient wealth was found in the gold washing of the Kurumbar. We must hesitate to take minimum results of Kurumbar efforts as any measure of what is to be achieved under operations, by machinery, quite beyond the compass of simple gold washing.

In South and Central America, in many cases where regular mining had ceased, the Indians would, by a few days of river washing, get such a small quantity of gold as was required for their new purchases of goods from the traders. On this head some misconceptions prevail, for it is supposed that the gold washing is not kept up for some mysterious reason. The real reason of the casual production is, that the Indian is not by pursuit a gold washer, his food is obtained by other means, and the gold is sought as a special commodity, for

* *Herapath's Journal*, Dec. 4, 1880, p. 1881.

a special use. Gold washing, too, is not a favoured employment in most parts of the world, but one that is irksome, and is only carried out on a large or continuous scale by compulsion.

Nothing can be a better testimony of the neglect of a gold district than its falling into the hands of the native washers, who have only the simplest apparatus. The most inconsiderable application of better expedients, as of a cradle, alters the whole arrangements, and is attended with commercial results. The native gold washer can get through but little material, and, even when most expert, in some districts, sends into the current much of the gold.

Political events, as has been said, must have exercised the greatest influence on the alternations of gold raising in India. When we look back and consider the previous events, which have so affected the regions now attracting interest, we shall be able to allow or others far remote, or unknown to us. While gold, when accumulated, dazzles the imagination, we do not conceive the precarious course by which these accumulations have been brought together, and that, so far from its being in the nature of things that the collection of the metal should be constant and never be interrupted, it can only take place under very favourable circumstances.

In the early stages of discovery, it is very difficult to arrive even at an approximation to the yield. The assays can only be those of casual specimens, giving no real estimate of the result. An assay must depend on the sampling, and though this can be effected with a poorer ore like copper and lead, it is difficult with gold where a very rich metal is widely disseminated.

Even where assays are applied in a practicable way in gold mines, there is often a large difference between the assay and the practical yield, even when the tailings are assayed. Gold, from its nature, can be distributed in such minute fragments that it is not mechanically secured, but remains in the stuff, or is floated away. In a mine so productive as that of the St. John del Rey Company, in the Brazils, which has given dividends for above half a century, the best estimate is that the recovery of gold has only been from 70 to 73 per cent., leaving from 27 to 30 per cent. for possible loss, as the processes applied to the remaining material are successful only to a small extent. The only possible estimate to be formed is from the whole yield of a mine like the St. John del Rey, and then a large deduction must be made for possible loss of metal. For gold working there must be gold on the spot, but even then the commercial realisation is not secured. There is gold enough in the world, the existence of which is ascertained, but which is not extracted. This is the case in Central America, in Colombia, in Venezuela, in Peru, in Bolivia, in Brazil, in Africa, and, indeed, throughout the whole world. If the place has not facilities of access, if there is no good supply of suitable labour, and, above all, if there is not sufficient water, the mineral remains unworked.

If the mines must be worked and drained by powerful machinery, it may be impossible to place such on the spot, for want of roads suitable for conveyance. Even if machinery can be placed, it may be of no use for want of fuel, or for want of water-power. Thus a variety of conditions to be regarded in forming any opinion of the value of any district.

On account of the small quantity of met gold stuff, large quantities of material mu pounded in order to get it into a state for redu Thus, generally, water is an essential for all operations, unless the metal exists to suc extent, that the ore can be conveyed to an place for reduction. Where such is not the dition, the mines remain unworked in som climates, and where there is known to b enough.

II. So far as Indian gold is concerned, th tricts now under consideration are in a hill r subject to a very heavy rainfall. This is c off by streams, and in some parts will n available, and cannot be pounded or secure bends. There are, however, estates where str and in other districts storage, are availabl water. In fact, India in these respects advantages equal to most portions of the fornian regions, and beyond Australia. are few parts of New Zealand better provide are there in Brazil.

Thus, where an estate has a good reef on it the water well laid on, the prospects m looked upon as hopeful. Still, there wi vicissitudes, a season of short rainfall, the bur of dams, and various incidents, which interrupt steady working.

Calculations are put forward that a large inordinate amount of capital is already invest Indian mines, but it is quite idle to give figures. The greater part of the amount scribed being for the purchase of estates h gold formations, constitutes a mere transfer, the country is neither richer nor poorer, how individual wealth may be affected, and the c tion of one person or another. The true ap tionment of capital is for the export of machi and for the remittance of wages for workmen.

The truth is, so far from a large amount of ca being provided, it will be found in more tha case that the capital is insufficient. Wheneve large a proportion has been applied for pur money, the working will be starved, and e good mine may prove unremunerative. In cases, the first capital being exhausted, the ori holders may have to submit to a total loss, the next comer may get a large return on a small investment. These are the contingenc mining, and the large prizes draw people into operations. It is the last purchaser who ob the whole return for all the capital which has sunk in the concern.

The fact is, the absorption of capital will a great degree, self-regulating. Only a li amount of capital can, in 1881, be appli opening out, to working and to machinery same in 1882, and in 1883 very little capita be applied, unless some return has been seen will be found that so-called gold lands can sold for fabulous high prices, any more th nominal low prices.

A real loss of capital will be incurred by i cious provision of machinery. Wherever too a quantity of machinery has been sent out, n mining requirements, but to produce an eff the Stock Exchange, and to run up the sh

ss may be looked for. Whenever a mine ; of working, although the machinery may l and in fair order, it seldom fetches its s the removal of machinery is very difficult. When machinery is kept too long, during a ion, it likewise deteriorates, and may be l to old iron.

a the real investment of capital in India, hstanding much loss, a fair return to this y may be expected. Machinery makes a for other machinery, and so does the supply ineering workmen to a country. With a umber of such men attached to the mines, it ecome possible to introduce and use other ery not otherwise available. The expendi- r wages is not likely to be excessive; it will itself, as, when found unremunerative, it will pped. Even the large salaries of superin- ts and skilled officers cannot be a total loss as many of these men will remain, and open ier enterprises. A very good example of given in the *St. James's Gazette* of this g. In consequence of the increase of ery in the Linares lead district of Spain, e growers have taken to the purchase of d machinery, instead of the old wooden es. It will be noted that the Belgian turers, having got into the district, l the benefit of this new business, igh rather a speculative mode of regard- ; and other such operations, it is a true ;, whatever the direct result, there must l from introducing into India Englishmen gence and enterprise. Such considerations led to particular weight, when we come to ie national relations of such undertakings. e said, indeed, we are hedged against loss terial point of view. It is in this respect gland in the long run is found not to have oser in the many disastrous ventures in es of fifty years ago. The internal losses y painful to many over-speculative persons, the event, the country was no loser. h there was some loss in Brazilian mines, rs gave a return, and in the end we have ld on the produce of Brazil, which has in s of ways been a benefit to us.

st, it is from no single set of figures that influence and value of such operations can rmined, and they must be examined as a nd in their full results, with all their losses their gains. These the balance-sheet of a company will not disclose, as it will not ie effective distribution of capital. There loss to the shareholders, and gain to the turer and the merchant.

y important consideration is the supply of The want or failure of this has put a stop al industry in many countries. Thus, in n the Portuguese times, the numerous and ve mines of the auriferous districts depended labour. With the emancipation of the whole districts were thrown out of yield, and y by close attention that labour has been for the St. John del Rey mines, and the idends have been kept up. The supply of ust be free and continuous, and consist of are disposed to engage in such a product. ie strength of Chile, where the natives are to undergo the drudgery, and receive regular wages, or, as tributers, run their chance of the prizes of rich and casual finds.

It is likewise necessary to have English or other foreign miners who understand the business, and are willing to go abroad, and encounter, with or without their families, the vicissitudes of distant travel. So far as this population is concerned, we have it at home in Cornwall and Wales, whence many proceed, not only to English countries in Australia, South Africa, Canada, and the United States, but to foreign lands. They are as familiar with the hot climates of Brazil, Chile, and Mexico, as with any of the regions they frequent. Then there are our Australians. There would, consequently, be no difficulty in obtaining a supply of workmen for our Indian empire, where they are under English protection. The same circumstance will favour, in case of need, the introduction of foreign miners. The mass of the labour, however, will be local.

Our own people are well acquainted with gold mining in Australia, New Zealand, California, Brazil, and Columbia, and it is not a business that they have to learn, but one in which they have been largely engaged. Much, too, depends on the enterprise of such men, for many classes of working can only be carried on by the participation of such men as sharers or tributers, one of the forms of mining enterprise which distinguishes it from most branches of industry. It is, too, an inducement which brings in labour and intelligence, as well as capital; and mining depends, not solely on the capitalist, but, in many cases, largely on the co-operation of the working men, who share the risks as well as the profits. Thus, the risk of the capitalist is sometimes reduced; but, at all events, something more than the efforts of the capitalist is brought to bear, and so it will be in India, where the individual labour will be stimulated by an incentive beyond the wages of labour.

III. Apart from any operation on the coinage of India, and on the exchanges, it is to be expected that a much more important influence will be effected on local prices of wages and commodities. Looking at these from an English point of view, it has been too much the custom to consider them as dependent on English conditions. There is, however, very little contact between what may be called the English system of prices, and the Indian system of prices.

The contact is effected by the export from India to England of sugar, coffee, rice, cotton, jute &c., the prices of which for export are determined by the London or European market prices. This, however, exercises very little influence on the main bulk of the agricultural crops of India.

Far different are the relations between England and the countries on the adjoining seas, Ireland to the west, and the shores to the east and south. Every pound of meat, every fowl, every egg, each pound of butter, and all fresh vegetables or fresh fruits, are liable to be taken up for the great markets of London and Paris, the prices of which, with the cost of transport, govern those of the outlying districts. Hence, the general complaints of the growing dearness of living in the large and small towns, and which tends not to a levelling of prices in the proper sense, but to an augmentation of prices to the higher standard.

Within each region, the completeness of railway

transit contributes to such results, and the seas are bridged by steam transport, also penetrating the rivers. The prices of food affect the prices of labour to a considerable extent, and modify the operation of other causes. The Irish labourer, who, half a century ago, received 4d. to 6d. per day, or Indian wages, now receives 2s. or more.

In India, as has been pointed out by me, in common with others, similar results have, of late years, been seen in operation, but they have not reached their full development, and must, therefore, continue until it has been attained. This is the point to which the attention of economists must be turned, because the quicker or slower rate of this development means the earlier or later attainment of an advanced condition by the population of India, and the consequent rate of public revenue.

So long as the great disparity of rate of prices between India and England exists, there must be a disturbance of all economical relations. There must be a really abnormal relation of imports and exports, an abnormal disproportion between the amount remitted to England and the rest of the revenue of India, a false relation between the supply of capital to India and its returns.

Taking this last head alone, India labours under great disadvantages as compared with many other countries. If a railway be made, say in the United States, with English capital, then the returns can be calculated upon at something like English prices. In India this is not so; the railway iron and machinery shipped from England is of the same identical cost, but the carriage of commodities and of passengers has to be underken on a scale wholly different. No question arises elsewhere, for instance, as to the carriage of passengers at 2 pice per mile. In some countries it is possible to charge an anna or two, as here at home.

That, in many classes of enterprise, where the amount of traffic, or transport, or commodities dealt with in India would, at what may be called normal rates, produce a good return, in India they give an insufficient money yield, the undertaking becomes impossible with profit, or without a guarantee burdensome to the Government, and the abundant capital of the European markets is not applied to India, while it is freely available for alien countries, which have no claim on English sympathies, in Brazil or in Chile.

It is the rise of prices now going on in India, and already referred to, which will act independently and concurrently to affect the situation, and dominate the commercial and financial conditions. It is, therefore, perfectly futile to talk of the application of great economical laws, when we neglect the circumstances on which their operation depends.

The development of gold working means the development of English knowledge and enterprise, and the consequent progress of India. Then the railway system will no longer be stinted, and the correspondent benefits will be obtained. Many a commodity will rate locally at a higher price in consequence of higher wages, but the efficiency of railway transport, as compared with the bullock cart, will place the commodity at the port, under commercial conditions. Many commodities, which now cannot be moved and are excluded from trade, will, under quick transport, become exchangeable articles of commerce. If these resul were only to be regarded as possible or probabl the whole subject of the gold fields would be wort of the gravest consideration, and as one not to dismissed on doubts, or on the absence as yet ascertained realisation.

Nothing, indeed, is more familiar to the old Indi statesman and resident than the alteration and r of wages and prices which have come home to hi in his own time, a rise which has been continuo and the conditions of which we know will never reversed. Even in the Wynaad this has been striking as anywhere else. In 1833, rice was 20 30 seers to the rupee, and a sheep, even Ootacamund, 12 to 16 annas. In 1833, the wa of labour were 2 annas 6 pice per day, but earnings of a Kurumbar gold washer were estimated at 2 annas per working day.

In 1876, the Prince of Wales's Company from 4 to 5 annas a day, and it may be that in Australia the wages are more sh than annas, being from 6s. to 8s. per day.

This rise of prices, which strikes every recorded by Sir Richard Temple as a gener affecting India, and is, in this respect, bro forward as a topic in his "India in 1880."

The time must come with the working of gold regions of India, that the wages will be pr tically the same in Wynaad as in Victoria, and will not impede the gold workings, because Victoria, the poorest stuff is raised to a profit high wages and high-priced food.

IV. It is difficult, in any reasonable compass, giv a fair idea of the extent of the gold regions India, or to effect this by either historical or to graphical treatment. If at the present mo the Wynaad regions concentrate attention them, they cannot be regarded in any gen consideration as entitled to sole notice. Ot districts in ancient times were better known, there are mineral formations in outlying regi which, on examination, may prove to be producti and which may give unexpected value to count now regarded as undeserving of attention.

On this occasion, we must direct our notice Wynaad and the neighbouring lands. These m certainly be considered as an old and recogni gold district, at whatever opinion we may h arrived as to its practical utility. The old worki attest its former and continuous occupation mining, while the petty operations of the na gold seekers preserve the tradition, rather th prove, the extent or importance of the formati More than once, in later times, attention has be directed to the possibility of turning these indi tions to account, and that chiefly in dependence the historical indications. The earliest histori evidence, however, that we as yet possess, is th brought forward by the eminent authority on archæology of India, Dr. Burnell, quoted by Eastwick and Mr. Brough Smyth. In his note the Great Temple of Shiva, at Tanjore, he is opinion that it could only be by gold treasu that the Rajahs of Southern India could rais the eleventh century the great temples to Shi and in the twelfth and thirteenth centuries those Vishnu. Were there nothing else to support this conjecture would fall to the ground, beca the temples were not really constructed with go but with labour, like the pyramids of Egypt, unl

labour or food had been imported from without, and paid for with gold. Any gold expended within the country would, under most circumstances, remain within it, and be again collected into the treasury. Dr. Burnell, however, brings direct proof as to the abundance of gold, by his successful decipherment of a remarkable inscription in the Tanjore Temple. Dr. Burnell is thus enabled to state that in the eleventh century gold was still the most common precious metal in India, and stupendous quantities of it are mentioned. He, too, considers that this gold was obtained from mines, and that the Moslem invasions interrupted their workings. This is the opinion which appears best to account for the facts known to us.

Mr. Edward B. Eastwick, with his accustomed power of research in Oriental history* has treated of the historical data. He records that, in 1293, Allâhu'd-din took the City of Deogarh, and ransacked the citadel, receiving besides 175 lbs. of pearls, 50 lbs. of diamonds, and 25,000 lbs. of silver, as much as 15,000 lbs. of gold. Although this is supposed to be an exaggeration, there is no reason to deal with it as other than the actual conditions of the treaty made and recorded, though the value of the gold would be some £600,000 sterling. Such a treasure is by no means unexampled in history. Indeed, the accumulation of treasure was as great a political end as was the increase of territory, and each conqueror possessed himself of the accumulated stores of his victims.

Tippoo Sultan possessed great quantities of gold. In Maxwell's "Life of Wellington," it is stated that he was to pay to Lord Cornwallis, under treaty, three crores and thirty lakhs of rupees in gold mohurs, pagodas, and bullion, equal to about £3,300,000.† On one occasion, Tippoo sent thirty-eight camel loads of money to Scindiah, to buy him over as an ally. By the estimate of treasure and property taken at Seringapatam in 1799, it is clear that Tippoo had been able to make fresh accumulations of specie; there were 16,740,350 star pagodas. His throne had, at least, £30,000 worth of gold in it. Besides this, he had paid large sums abroad for war supplies and political purposes.

Whether this gold was obtained from the mines of Southern India is uncertain, though the Commissioners, in 1833, state, "it is pretty certain that Tippoo attempted to make them a source of revenue during his possession of the country" which was included in his dominions. Indeed, all the English inquiries turned on this point of the known existence of the metal. In 1792 and 1793, a joint Commission, from Bengal and Bombay, was appointed to examine the state and condition of the province of Malabar. The Commissioners refer, briefly, to the occurrence of gold, in treating of the subject of the royalties claimed by the rajahs, which is stated to be on "all gold ore," and also of "compositions of gold," which were found in the Nilambur district.

In 1793, Mr. Duncan, Governor of Bombay, formed a strong opinion of the value of the mines, and took some steps to ascertain the extent of them. In 1802-3, the auriferous rocks of the Nilambur valley are again mentioned, and, in 1813, a work was published by Dr. Whitelow Ainslie, in which an account was given of the localities where gold is found in India. He says, "Gold dust has been found in the bed of the Godâveri, and in Malabar in the bed of the river, which passes Nilambur in Irnaad district. It has, moreover, been procured in very small quantities in Wynaad, in the Arcot district, and in the sand of Beypore river, near Calicut. Though the sources are evidently numerous from which this valuable metal can be obtained in the Indian peninsula, it would seem, from the little interest they have hitherto excited, that none of them promised to be very productive."

* See "A Hand-book for India;" John Murray. Article in Gentleman's Magazine." Letter to the *Times*, 2nd Jan., 1879. Quotations from the same in "The Report on the Gold Mines of Wynaad." By R. Brough Smith, London, 1880.

† See authorities already quoted.

It must not be argued that the Indian authorities were so very remiss, for, apart from political disturbances, which attracted the attention of the authorities, there was no school of gold-mining in England. Such existed in Germany only, and the subject could, in England, be studied from books alone in a most imperfect manner. It was only at a later time that Englishmen were employed in gold mining and reduction in America and became conversant with it. It was not, however, until the Australian discoveries that we obtained a large and organised school within our own empire, which now justly holds a high rank. Indeed, the Spanish, German, and Russian schools are now connected with smaller operations, while the English and American schools are supported by practical works on a much larger scale. It is also by these schools that the application of machinery has been carried out, beyond the examples of the other and older branches of professional mining.

While this state of affairs accounts, to a great degree, for the assumed neglect of the Indian formations, it also accounts for the failures in the next epoch, when the Indian authorities more seriously and more earnestly turned their attention to their gold resources. Before the year 1831, Mr. William Sheffield, the principal Collector in Malabar, had been buying gold for the Government, and on the 10th January, 1831, he sent in a report on the several localities where gold was known to be found, and on the methods of mining employed by the natives.* Mr. Sheffield made such an impression that Lieut. W. Nicholson, 49th Regt., N.I., was appointed by the Government to search for gold "in the mountains on the Malabar coast," and with him was associated Mr. Henry Louis Huguenin, a Swiss, as to whose qualifications we have no information. It may be mentioned that Lieutenant Balfour, R.A. (now Gen. Sir G. Balfour), being at Cobar in 1835, noticed that his servants washed gold there. Every resident told him of gold. Such facts were of constant observation.

It will serve to show what erroneous and exaggerated ideas prevailed, that Mr. Huguenin stipulated with the Government that he was to have one half of the gold he might assist in finding and reducing during a period of twelve months, and the same proportion of all gold he might collect from the mountain streams, &c., by washing; the government having the right to take such share of the produce at the market price of gold.

Had the Government, or its conductors, had the advantage of experience elsewhere, they would have known such conditions were impracticable.

* All this is derived from the sources previously quoted.

All the greed of the Governments of Spain and Portugal had resulted in their accepting a small tax or royalty in Mexico, Peru, or Brazil, although they might retain their monopoly of mintage or purchase. The Madras conditions could only result in disappointment.

Lieutenant Nicholson's mission was one of those in which our Indian officials have equally shown strength and weakness. With no practical knowledge, and with second-hand information as to European processes, but applying intelligence to the improvement of rude native processes, they have often succeeded in establishing large and successful works. Such was the success of the late Joseph Hume, in setting up gunpowder works. So, too, the late Mr. Heath succeeded in making the finest steel, and though he did not achieve a commercial success in India, yet this able civil servant was enabled to discover valuable processes, and in his day to revolutionise the steel trade at home. Some of the first irrigation works, too, are noble monuments.

The zeal and exertion of Lieutenant Nicholson deserved a like success, but, as has been shown, circumstances were against him. He carried on a course of explorations in 1831 and 1832, and we are now able to recognise that he showed great ability, and that he achieved a certain success. His dispatches will be found in the report of Mr. Brough Smyth, already referred to. Mr. Smyth, with an appreciative feeling, has produced Nicholson's map, which shows that Devala and many other gold sites were recognised. The party of Lieut. Nicholson suffered much from fever, while his prospects of success were lessened by the want of a sufficient number of assistants, by bad tools, and by an irregular supply of necessaries for his men. In fact, he was in the situation of some of the early parties in Australia and New Zealand, which, from like causes, failed in what afterwards proved to be fertile ground for others. He had, however, peculiar difficulties, for the petty rajahs caused obstruction, they misled his people, filled up shafts, and felled trees to stop the paths. As treasure was not found at once, nor seemed likely soon to be found, there was great discouragement, and on the 25th of May, 1833, the Right Hon. the Governor in Council dispensed with the services of Lieut. Nicholson, and appears to have abandoned all hope. They did not attempt to remedy the manifest defects of the expedition, they did not follow up its indications, but determined that success was impossible, and the belief was arrived at that gold did not exist for any effectual purpose. The Kurumbars, however, went on with their small scratchings, as they may be called, and did this further good, that they kept alive the memory of the gold formations.

In truth, the labours of Mr. Sheffield and Lieutenant Nicholson were worthy of a better fate. The attention of Mr. Sheffield was naturally chiefly directed to the river washings, of which he knew many sites. He also referred to Wynaad. He, however, repeated that "There appeared no reason to doubt that golden ore is homogeneous to the soil in the mountains and hills of Malabar." He proceeds to name Devala.

Lieutenant Nicholson came across many curious facts. In one place he found no less than 27 old shafts. In another he observed 500 or 600 Moplahs working regularly, and paying roy to the local zemindar or rajah, to the ext some £700 a year. He sent up some stuff the Devala mines, which gave metal in the portion of about 90 per cent. of gold, and cent. of silver, and a portion of copper.

Silver, so often associated with gold ore pears to be a large constituent of those ore it will give occasion for the operations of ing, which can be affected in the presid mints.

One strange business of Lieutenant Nic appeared to have been the purchase of gold, view to an operation on account of the G in which Mr. Sheffield had also been engage

It is to the credit of this officer that he s own deficiences, and proposed to go to Engl purchase machinery. He also offered a pl forming a mining department and school in by means of the Company's establishme Chatham. These recommendations from a man had little weight with the Government, may be regarded as even less informed than hi In the case of the gold regions, as in other in India, it will be found that English intell and enterprise are the real and efficient engi the improvement of our empire, and m applied in a fuller measure than the staff c Government can supply.

It will be observed that the fever incident t district was regarded, half a century ago, as now, as a serious impediment, and this w discouragement for gold working. It so happ that the availability of the district for c planting engaged attention, and when once was seriously undertaken, Wynaad and the n bouring countries were occupied, and turn account, notwithstanding all obstacles. planters gradually became aware of the finding, and turned their attention to it.

In October, 1857,* the acting collector of bar drew attention to the arrear of taxes p by the rajahs for the right to mine, and so formation as to the gold workings is derived his reports. He could not define the localities in which the gold was quarrie washed, as it was obtained in very many interspersed though a tract of country exte for 30 or 40 miles along the western face Ghauts, and in parts along their summits stated that circumstances had altered so that the business had greatly gone down ten years, so that many of those who unde the art had betaken themselves to other pu and had carried away with them the knowle the localities richest in ore. As it was, m the work, as it had been in Lieut. Nicholson's was carried on by slaves; a significant testim the poor returns. By 1858, whole families ha diverted to the employment of the coffee pl It was about this period that, for a time, I as honorary agent to the Association of Plan Western India, and the gold resources o region particularly attracted my attention.

It was not until 1868 that the matter o working was seriously treated, and then b tralians who had settled in Wynaad. In J that year, Mr. H. S. Sterne, who had six

* See authorities recorded.

ience as a gold digger, applied to the Govern- for leave to prospect for gold and other s on Government land in the Madras Presi- '. Permission being granted, he prospected in us places, but with what success is not known.* where about the same time, Mr. G. E. ers began to prospect, and became convinced spection that the reefs were auriferous, and ving of attention. Owing to his labour and nterprise of Mr. T. W. Minchin, of Hamslade, Devala, machinery was erected for reducing uartz found in the veins of the Skull Reef, and s within the area of the company, which was ed the Wynaad Prospecting Company.

rom this period, applications have been con- ed until now for permission from the Govern- t to work gold on private estates or on public d. These operations attracted much attention, l culminated in what appeared to be, in 1876, a tled industry of gold working, but the trials oved unsatisfactory, and, from one cause or other, great discouragement prevailed.

he chief of the original Wynaad companies were, er the Prospecting Company, the Alpha Mining mpany and its dependency, the Prince of Wales artz Reef Gold Prospecting Company. These mpanies were chiefly under local auspices. By time the Government of India had obtained services of Mr. R. Brough Smyth, then in the loyment of the Government of Victoria. As to r operations, much information is contained e Appendix A, dated 18th February, 1879, to report of Mr. Brough Smyth, p. 63. This report from Mr. Smyth to the Acting tary to Government in the Revenue Depart- in consequence of instructions, under date anuary, to ascertain how it was that, with gold ground, the Alpha Company had not ded. The mining operations of this company in February, 1875, and ceased in March, during which about 780 tons were raised he main Skull Reef. From this only 91 of gold were obtained, or at the rate of . 8 grains per ton. Of this, however, 6½ tons l at the Wynaad Prospecting Company's yielded 19 dwts. 22 grs. per ton, or nearly ce. The operations were, therefore, on a nall scale, and afford very small materials iving at a judgment.

the 1st June, 1877, the Prince of Wales's ny took possession of the Alpha Works agreement, but did not begin work until the August, 1877, continuing to mine until the February 7th, 1878. The value of the gold s rather more than 8,000 rupees from about s, and even that is not a mercantile result. erage yield was nearly 10 dwts. 12 grains.

ppears the machinery was inadequate, but a cause of failure was the roasting of the in kilns, before sending it to the mill. The eported was that the fusible lower sulphides the gold, and prevented its amalgamation. comparing the average yields with those ed by Victorian statistics, Mr. Smyth found ields in Victoria favoured large results and lividends. He came to the conclusion that dequate arrangements the Alpha property to give very good returns.

* Report of R. Brough Smyth p. 10

Among the vicissitudes of this history, is to be recorded that parties involved in the disaster of the great Glasgow Bank, were concerned in these mining operations. It fortunately happened that some far-seeing men, among whom may be mentioned Mr. R. Palmer Harding and Mr. Samuel Jennings, determined to turn the gold properties to account. Thus a new element of enterprise favoured the contest.

At the same time, the sagacity of the leading director in the Moyar Coffee Company, Mr. W. J. Rhodes, gave further strength to the new movement. Mr. Rhodes, with his colleagues, acquired the mining rights for the Coffee Company, and thereby obtained for it advantages of an exceptional character, though these services have not yet been adequately compensated.

The conviction impressed on a number of able men of the real character of the district, resulted, naturally, in the determination to prove its resources. The missions of Mr. R. Brough Smyth to South India, for which he was retained by the Moyar Company, undoubtedly greatly co-operated to strengthen these efforts, and to consolidate public opinion. Bringing to bear an acquaintance with Australian operations, his enthusiasm did not exceed his caution, and if any have been excited by his descriptions, they must have neglected the reservations he expressly made. Going into a country which, to the regard of others as well as of himself, presented the aspect of a great gold region, he had to give some general appreciation, by which its character could be understood. For this purpose he laid down broad lines, but with the express reservation that these were not determinate, and were subject to correction.

In despite of himself, many believe that the reefs, roughly sketched, are as exact as the determinations of the Indian geological survey, and that deductions may absolutely be drawn from such data. Other observers have applied themselves to the task of working out, in detail, some particular reef, and have given to it a more precise bearing, differing from that proposed by Mr. Smyth. At page 18 of his report, this gentleman says:—

"It has been considered advisable to use great caution in suggesting the probable connexion of the outcrops of quartz, as they appear on the surface—in laying down hypothetical data—so as to connect one outcrop with another. The direction of the lines of reefs may, from the surface indications, be guessed at; it can be ascertained in no other manner than by extensive explorations; and the facts mentioned in other parts of this report justify hesitation in laying down, as absolutely beyond question, any line of reef in the Wynaad."

He enforces this from the experience of Australia.

Nothing can be clearer than Mr. Smyth's warning (p. 19)—

"It is not unlikely, however, that the first attempts will fail. Speculative undertakings having for their object the making of money by buying and selling shares, are commenced invariably by appointing secretaries and managers at high salaries, and the printing of a prospectus. This is followed by the erection of costly and not seldom wholly unsuitable machinery; no attempts are made to open the mine; and then, after futile endeavours to obtain gold, and a waste of capital, it is pronounced and believed that gold mining on a large scale will never prove remunerative. It is pro-

bable that this will be repeated over and over here, as in other gold mining countries, until some one of the mines is opened by experienced persons, who desire to secure profits, not by dealing in shares, but by mining."

In the last year, 1880, and in this, numerous companies have been formed on a large scale, and great speculation in the shares has taken place on the Stock Exchange. While we may look for fair results from fair mining, and, it is to be hoped, for large dividends, after a difficult time, we must also look out for a large amount of individual loss, to be measured only by the greediness of the speculating persons. Some of these losses will be most severe, as, step by step, the gamblers are drawn in, stimulated by the real or supposed gains of others. Those buying at the top of an exaggerated premium will sustain all the distances of fall from that height to the lowest collapse, when the concern is sold off as worthless. Then the premium will be lost and also the subscribed capital. It will, however, be seen that the community will not suffer in the same degree as the individual, for the man who sold at the premium will have his premium. So, too, the subscribed capital will not be lost to the community, as what is paid to several of the companies for the purchase of the properties is a mere exchange. Much of the operation is, indeed, a gambling with counters, and none the less to be reprobated.

V. Some very good descriptions of the Wynaad and the Mysore districts have been published in the memoirs accompanying the Geological Survey of India, particularly the report and map of Mr. King, in May, 1875. Mr. Brough Smyth, in his reports, has entered into valuable local details. Mr. Oliver Pegler has given a general mineralogical sketch of much interest, which he has confirmed by subsequent explorations.

A map of the gold regions, by Mr. James Wyld, the Geographer to the Queen, is the best record we have as yet of the general conditions and the various discoveries.

Mr. Oliver Pegler says* that the range of mountains of the Wynaad is of ancient formation, belonging to the paleozoic period, more especially to that of the Silurian formation, a matter of much interest. The highest peaks, as in the neighbourhood of Ootacamund, are formed of hard, dense, and crystalline rocks of the metamorphic series of granites, syenites, &c. The more fissile varieties are also here present, and, being softer, have yielded to the disintegration and denudations of time, and have formed the valleys and dells adjacent to the peaks.

These softer rocks are of a much higher colour than the harder granite and crystalline formations, and give a red and brown appearance to many portions of the surface of the country. The average height ranges from 7,400 to 8,400 ft., and the whole of the formations are impregnated with black magnetic oxide of iron, which, after a shower of rain, appears as black sand on surfaces where the water has run over in streams. This is particularly noticeable along the road sides. The crystalline rocks continue for a considerable distance down the slopes towards the Wynaad country, becoming lighter in colour, coarser in texture, but more laminated and fissile in structure, changing into the gneissic and more laminated varieties of metamorphic rocks.

* *Mining Journal*, January 17th, 1880, p. 67. In the *Mining Journal* will be found preserved, as customary, the current information on the subject.

The extent of the available working ground in the Wynaad is, says Mr. Pegler, very great, and Mr. Brough Smyth, within a small area of 2[illegible] miles by 12, or some 250 square miles, determined no less than 90 outcrops of ore reefs. Some of these surface specimens were very rich, at the rate of £750 worth of gold to the ton.* The Monarch Reef, near Devala, has been traced far above nine miles. The Mysore district is equally well spoken of. There is no doubt, indeed, of a truly auriferous region, and one of good character, extending over a wide area.

The whole surface of the ground, writes Mr. Pegler, is contorted, upheaved, and thrown about, forming upright ridges, valleys, peaks, rounded hills, and depressed surfaces. It is most difficult to determine the true strike of the strata generally. The whole country is ramified with a run of gold quartz veins, which are true reefs. The general run of these reefs is parallel, the direction of strike, according to Mr. Pegler, being almost generally, in the Wynaad, north and south, a few degrees west of north, and east of south. The dip of the reefs is very low, as seen at surface, and most generally to the east, varying, when cropping out on the brow of the hills, especially when heavily developed, from almost horizontality to from 20° to 39°, and increasing in dip in lower grounds. These reefs, which are met with in every part of the country, are often of great breadth, up to 15 ft., 20 ft., and 30 ft. of thickness, are composed of white crystalline, compact quartz, identical in every respect with the reef quartz of Russia, Australia, California, Nevada, or any other known gold-bearing country.

Such being the resources to be worked, there come questions as to the local means for working. Water, the great necessity for gold crushing, where fuel is not readily available, is supplied by a heavy rainfall. Mr. Brough Smyth states that the rainfall at Devala, during the years 1869 to 187[illegible], varied from 109 inches to 117 inches, and at Vellerymulla, during four years, from 100 inches to 139. As much as one inch of rain sometimes falls in an hour, and nine inches in a day, the destructive effects of which in some places may be conceived.

Where water is scarce and fuel dear, a relatively rich spot may be less valuable than an estate with a poorer gold reef.

The next natural commodity is timber for mine timbering, and tools, and for fuel, and this, within certain limits, can be freely obtained. It will tax the forest administration† to keep up this supply, and to prevent waste.‡

Labour, apart from technical labour of imported miners, is available on the spot. The Moplahs and Kurumbars have also been accustomed to gold working. The coffee plantations have trained up labourers. It will, however, prove fallacious to form estimates on the present rate of wages.

So far as Europeans are concerned, climate is to

* *Mining Journal*, already quoted.
† See Sir Richard Temple's Paper, Society of Arts' *Journal*.
‡ A list of woods supplied by, will be found in Mr. Brough Smyth's Report, pp. 58, 59.

ısidered. With a heavy rainfall, and luxuri- ɜgetation, malarious localities are prepared, ıere are seasons and places to which English- ihould not be exposed. Miners, however, r work under ground, and in mines at home ɜry high temperature. There are, however, where the coffee planters are able to reside ir estates with their families during the whole Then there is the station of Ootacamund, a : for health and pleasure within the neigh- ɔod, which will afford a great resource. A g district, with a floating population, is not, rer, to be regarded as a colony, like New ad, in which men are to spend their lifetime d age.

essibility may be regarded in connection with her conditions. Within four miles of some Mysore mines, is a railway station in union the main Indian system. Although the e railway to Ootacamund has not yet been ucted, the plan is delayed for want of rt, and gold operations will stimulate its ıencement. From such particulars as to these as have been kindly afforded to me by Mr. d Danvers, the head of the railway depart- , and Col. J. F. Smith, the chairman of the as Railway, there appears to be no reason esitation as to some provision for passenger it being ultimately made. So far as Wynaad ıcerned, there is the great advantage of access licut and other ports on the western coast, n 30 or 40 miles of some of the gold-bearing ıtions, the elevation to be reached is, as already ibed, great, and to be ascended over a country ı cut up. Thus, with a seaboard nearer than ew South Wales, Victoria, Queensland, or ɔrnia, and more accessible than San Francisco, ng heavier than a few hundredweights can now t up to a mine without difficulty and uncer- r. All the weight has to go up, supplies for and mines—except such food as can be locally but the weight to go down is in pounds of easily to be carried—a return freight quite out oportion.

the seaboard, machinery can readily be placed, but it must be so devised as to be suitable for mountain regions. Upon the general nature of gold machinery in Australia, the recent paper of Mr. Alfred S. Lock, read before the Society of Arts 19th January (*Journal*, p. 131), and the adjourned discussion in *Journal* of the Society, p. 160, may be usefully referred to. As chairman, I made some remarks from my own experience and observation, not without connection with the present paper.*

With regard to gold lands and regulations, the Government have dealt with the matter judiciously. They have not been led astray by false notions of administration, and of large gains to be directly enforced, but have turned their attention to the practical experience of Australia.†

The late Governor of Madras, the Duke of Buckingham, showed a liberal appreciation of their importance, by visiting the gold regions on the 1st November, 1878, when gold was found in his presence.

VI. If gold should be produced extensively, it will settle the question of currency and exchanges, for not only will gold be at hand for coinage, but silver, thereby diminishing the import of silver. The Wynaad gold has a large proportion of silver, say 15 per cent. in weight.

Mr. Daniell‡ and the *Economist* have pointed out how large a proportion of the import of specie into India consists of gold. Although during the latter years the import of silver rose so high as to be from £16,000,000 to £20,000,000 per annum, yet the gold import also ranged high, reaching in one year nearly £10,000,000. In the latter period we have the extraordinary silver import of nearly £16,000,000 in 1877-8, yet the gold import was kept up steadily. Upon this Mr. Daniell rightly dwelt, and it is of such material import to the consideration of a gold currency for India, that it will be very useful to reproduce the tables in the *Economist* of 27th November, 1880.

* Mr. Lock also proposed a Gold Institute, which is well deserving of realisation.

† See report in R. Brough Smyth's report.

‡ Book of Mr. Claremont Daniell hereafter quoted, and his letter in *Bullionist*, 23rd October, 1880, p. 1103.

: of GOLD and SILVER respectively imported into British India, by sea, on Private Account and on account of Government, from the United Kingdom, China, and other places during the official years 1869-78.

GOLD.

	1869.	Per cent.	1870.	Per cent.	1871.	Per cent.	1872.	Per cent.	1873.	Per cent.
	£		£		£		£		£	
;nited Kingdom	1,595,893	31	1,609,484	28	498,207	18	1,340,696	38	751,417	29
....	1,501,210	29	1,542,785	27	1,505,352	54	1,331,746	37	860,968	33
places	2,079,873	40	2,538,131	45	779,015	28	901,336	25	1,009,986	38
	5,176,976		5,690,400		2,782,574		3,573,778		2,622,371	
	1874.		1875.		1876.		1877.		1878.	
	£		£		£		£		£	
;nited Kingdom	273,472	17	454,621	22	267,228	15	480,666	33	203,093	13
....	812,651	49	1,083,584	52	1,032,982	56	406,029	28	845,212	53
places	562,685	34	551,031	26	536,171	29	557,017	39	530,622	34
	1,648,808		2,089,236		1,836,381		1,443,712		1,578,927	

Silver.

	1869.	Per cent.	1870.	Per cent.	1871.	Per cent.	1872.	Per cent.	1873.	Per cent.
	£		£		£		£		£	
The United Kingdom	3,165,863	32	2,041,224	25	200,796	7	5,560,815	69	1,107,329	57
China	2,953,835	29	3,707,567	45	1,247,854	47	1,324,141	17	161,273	8
Other places	3,859,280	39	2,515,616	30	1,213,599	46	1,115,079	14	665,612	35
	9,978,978		8,264,407		2,662,249		8,000,035		1,934,214	
Price of Silver in London ..	60 7/16d.		60 9/16d.		60½d.		60 5/16d.		59¼d.	
	1874.		**1875.**		**1876.**		**1877.**		**1878.**	
	£		£		£		£		£	
The United Kingdom	2,147,305	52	4,376,881	72	1,979,566	57	7,305,278	73	12,716,330	81
China	912,967	22	353,303	6	349,507	10	610,472	6	1,761,728	11
Other places	1,083,454	26	1,321,627	22	1,135,268	33	2,076,658	21	1,298,474	8
	4,143,726		6,051,811		3,464,341		9,992,408		15,776,532	
Price of Silver in London....	58 5/16d.		56⅞d.		52¾d.		54 13/16d.		52 9/16d.	

Value of Gold and Silver respectively Imported into British India from Foreign Parts in each of the undermentioned Official Years:—

Official Years.	Gold.	Per Cent.	Silver.	Per Cent.	Total.
	£		£		£
1855-56..............	2,508,353	22	8,792,793	78	11,301,146
1856-57..............	2,176,002	15	12,237,695	85	14,413,697
1857-58..............	2,830,084	18	12,985,332	82	15,815,416
1858-59..............	4,437,339	34	8,379,692	66	12,817,031
1859-60..............	4,288,037	26	12,068,926	74	16,356,963
1860-61..............	4,242,441	40	6,434,636	60	10,677,077
1861-62..............	5,190,432	35	9,761,545	65	14,951,977
1862-63..............	6,881,569	33	13,627,398	67	20,508,967
1863-64..............	8,925,412	39	14,037,169	61	22,962,581
1864-65..............	9,875,032	46	11,488,320	54	21,363,352
1865-66..............	6,372,894	24	20,184,407	76	26,557,301
1866-67 11 months	4,581,472	35	8,655,433	65	13,236,905
1867-68..............	4,775,924	41	6,999,450	59	11,775,374
1868-69..............	5,176,976	34	9,978,978	66	15,155,954
1869-70..............	5,690,400	41	8,264,407	59	13,954,807
1870-71..............	2,782,574	51	2,662,249	49	5,444,823
1871-72..............	3,573,778	31	8,000,035	69	11,573,813
1872-73..............	2,622,371	58	1,934,214	42	4,556,585
1873-74..............	1,648,807	29	4,143,726	71	5,792,533
1874-75..............	2,089,236	26	6,051,810	74	8,141,046
1875-76..............	1,836,381	34	3,464,341	66	5,300,722
1876-77..............	1,443,711	12	99,92,402	88	11,436,119
1877-78..............	1,578,927	9	15,776,522	91	17,355,459
1878-79..............	1,463,049	20	5,593,699	80	7,056,748
1879-80..............	2,050,392	18	9,605,001	82	11,655,393
	99,041,593	30	231,120,196	70	330,161,789

As these two questions of currency and exchange are closely connected, so, in the joint considerations, they have been mixed up, and the difficulty of arriving at a consideration has thereby been aggravated. I am not unaware that the opinion of many of my friends among the economists is opposed to a gold currency in India, but, with *every respect* for theoretical considerations, it will be gratifying to see the solution of facts. The currency settled, the exchanges will settle themselves in a manner satisfactory to economists.

As there are two schools of thought in political economy, and although the historical school of the old English economists is rather out of favour there will be no harm in regarding India historically. History shows us that it had an abundance of gold and a gold currency, so that, although prices were small, the small gold fanam was a favourite coin, just as we find similar minute coins in the regions to the westward. It is, however, believed by many to be impossible to work a gold currency in India. A gold currency, nevertheless, will work with a low rate of prices, and we are not obliged to regard a gold currency as a matter solely of sovereigns and mohurs.

In those ages, when India raised gold and traded with the Arab regions to the eastward, there could have been no great difficulties, for in those regions the range of prices was also low. The Mussulman conquests disturbed the sources of gold supply in India, and reduced the stock, and at length we come to the state of affairs which we have in this day, wherein India has not merely to contend with the metallic question, but it is brought in contact with the enhanced prices of the west, and with machinery of production which destroys local manufactures. A like conflict is going on in Japan. In both countries a partial remedy is being obtained by the rise in wages and commodities. The contest is, however, with a growing antagonism, because the process of mechanical invention in the west creates an ever craving demand for these new and most expensive appliances of civilisation. Railways, iron and steel ships, and arms of precision, typical necessaries of the new social system, are only to be acquired at a real sacrifice by the undeveloped nationalities.

While Australia can make its payments with

ol, and Peru with guano, India has to provide many parts for a most dense population from the oduce of the soil. Commodities for exchange and port are only to be obtained by displacing articles food. Undoubtedly, the local circumstances of dia are peculiar, and create difficulties in the y of adjustment, but these can be met by due ovisions. In this, as in other cases, India must administered and legislated for, not directly on stern considerations, but in reference to its own rcumstances, still always with the direct end of inging India to the standard of the empire and f Europe.

It is the fact that, historically, India had a gold oinage, and there can be no local objections to its aving a gold coinage now, as well as a silver oinage; indeed, any objections to this must come om the outside. In the world we find a gold inage predominant, and those who object to a old coinage for India are those who object to imetallism as a system, and maintain a gold curncy here, and are, consequently, to some degree, consistent. Undoubtedly, any change in India ust be attended with disturbance, and this is raised s an objection to change. The disturbance, owever, is already most continuous and severe n relation to the rupee currency, and the bjections to future disturbance become small n degree, when we have to regard the prospects of improvement to be realised. As to hange in India, there is no alarm to be entertained as to change by itself, provided that change e judicious. India, like the whole earth, is nder the dominion of change. That great engine f society, the railway, which affects the transit of men and the transport of commodities, has done, nd is doing its work of change in India and elsewhere, and the people accommodate themselves to t, and will never abandon it, but for some other improvement.

There are those, and these are many, who long since have advocated a gold coinage and a gold standard for India, in communion with the rest of the empire, and I have been among them. So strongly has this necessity been felt, that measures for its realisation were at one time far advanced. Had they been years ago put into operation, by this time the consequences of disturbance would have passed away, and India have been brought to its true position in connection with the rest of the world.

This has not come; the question has been taken out of the domain of practical politics and left in that of theoretical economy. With all due respect for economists, administration is not to be under the yoke of theoretical, miscalled political economy. The distinction has, unfortunately, not been sufficiently regarded, though in India there have been many statesmen whose political instincts have induced them, on more than one occasion, to adopt the rules of real reason in preference to those of scholastic doctrines. Political economy has suffered the reaction consequent on its abuse, and is threatened with absorption by the so-called social science, which is only a meagre substitute for political science. By attempting to apply political economy beyond its bounds, it has been exposed in more than one country to the supremacy of the socialist school. Nothing is of more moment to India than the rightful administration of political knowledge as an applied science. If its peculiarities are to be regarded, then its relation to the rest of the world is also to be regarded, for India is at this day bound to our empire by political ties, and to the world at large by commerce, and cannot be left in isolation. Many of its supposed peculiarities are common to other countries. Were India independent, as Chile or Peru, it would be drained, as it is now. Chile, for instance, has to pay as much to us in proportion for warlike supplies, for interest on railways and loans, for our share in mines and in commerce, and for the maintenance of the English colony there, as India does.

Most of the alleged grievances have no real connection with the necessity of English rule in India. This relation will have no more real effect when the condition of India is altered by the gold supplies. The gold supplies will be coined, and much of this coinage be exported, as is that of Australia. There is no reason, then, why this coinage should not be like that of Australia in sovereigns, although smaller coins may be struck for local use. Coins are not always used for circulation, some are hoarded, some used as ornaments, some re-melted by the goldsmith. In England even, many a sovereign goes into the chain maker's melting pot.

The balance of facts is in favour of a sovereign coinage for India, and then the silver rupee coinage would become token money. If India exports gold sovereigns, the exchanges will be under modified conditions, both as regards the imperial operations and those with abroad.

In my range of experience, there is one quality of the sovereign standard which particularly recommends it for India. The pound sterling is something more than an English denomination. As it is exempt from the tampering which has affected the currencies of so many countries, it is accepted in all the money markets of Europe as the chief denominator for what are called international currency or bonds. The London money market is also regarded as safe from the revolutionary attempts which have from time to time created alarm in continental countries. Bonds with coupons, solely or alternatively payable in the pound sterling, are preferentially dealt in in all the great money markets. They have an ultimate determinable value, giving them the character of a resource and a reserve under all circumstances, and they have a special property for purposes of remittance, either as bonds or coupons, for the settlement of transactions, constituting an effective international currency.

One great want of India is capital, for whether technical financiers for a time impede its application by an artificial entanglement with the public revenue, events will enforce the emancipation of capital from these trammels. At present, the supply of India, as compared with our colonies, or foreign countries, for public works, provincial or city loans, is most contemptible. When the demand comes in force, it will be on a large scale, and it will, therefore, be a great benefit to have the participation of foreign markets, as in the case of the late participation of the Paris market, which gave opportune relief.*

* It is impossible to quote all that has been written and said on Indian coinage. Before the Society, in this Indian Section, valuable papers have been read by Col. J. T. Smith, and have been stoutly contested. What can be read with much benefit is,

The chief points that are brought forward in this paper, are—That by traditions and history gold is known to be produced in Southern India; that the extent of the formations has been proved by successive explorations; that for the working of these formations there are to be obtained labour, water, timber. The effect of the production of gold has been explained with regard to currency and exchanges, and prices.

VII. In closing this paper, I must renew my acknowledgments to many who have assisted me, and whose names I have quoted, Mr. R. Brough Smyth, Mr. Samuel Jennings, Mr. W. J. Rhodes, Mr. Juland Danvers, Col. J. T. Smith, Mr. Andrew Cassels, Sir W. Rose Robinson, Mr. Claremont Daniell, Mr. James Wyld, Mr. R. Palmer Harding, Professor Rudler, Mr. O. Pegler.

DISCUSSION.

Mr. W. D. Powles said he had little or no experience in Indian gold mines, but he had experience in other parts of the world, and a word or two with respect to the profitable use of tailings from gold mines, which had previously proved unprofitable, might be of some interest as illustrating gold mining in general. His family bought the tailings of a mine in Colombia, which had been worked for the free gold alone, having made a contract to take them for 12 years for 50,000 dollars, whereas, until then, they had to be thrown away as useless. They erected a small furnace in a very rough way, and from those tailings produced a profit of three or four thousand dollars a month. Not long afterwards, his father sold his share for 165,000 dollars. Of Indian gold mines, he only knew what he had read of Mr. Brough Smyth's reports, and what he had seen at the School of Mines; and he knew, from the geological formation, that quantities of gold must exist in the quartz reefs; that there was no doubt about. The only question was whether it could be obtained at such a cost as would show a profit on the working. He regretted that the enterprise should not have a fair start, the amount of capital on which dividend would have to be paid being rather heavy. Even supposing it to be a *bonâ-fide* operation, the profit on the actual working expenses would have to be rather large in order to show a profit on the whole capital—he meant at the commencement, because he had no doubt that later on, when the proper appliances were imported, in order to produce the gold at its minimum cost, they would be able to pay a dividend on a much larger capital, but he regretted that it should be rather heavily handicapped at the beginning. His experience had been chiefly in the United States, in Colombia, and in South America, in both gold and silver mines, and, on another occasion, he should be glad to discuss both the mining and smelting of gold and silver ores.

Mr. Lock wished to say, in connection with Mr. Hyde Clarke's observation that the capital invested in machinery was the real capital, that that showed how important it was that the machinery should be of the very best description you could possibly have for the purpose, and in order to that, there must be suitable knowledge of what was required. A short time ago he had made the suggestion, from the ignorance which seemed to prevail on this subject, that this country wanted a Gold Institute, where the different appliances requisite for the proper treatment of gold ore could be examined, their merits tested, and the whole su thoroughly ventilated. Gold mining was a science must be studied like any other science. As Mr. I Clarke mentioned, suitable and unsuitable appliance already been used in India. Mr. Brough Sm report referred to a company started some time ag Alpha, which sent out some machinery with whic quartz cropping out on the top of the reef was cru it therefore must have contained all free gold should have been the very easiest material to dea possible. But so far from getting gold, they lost a mercury, and the company came to grief, not b there was no gold in the ore, but because the appa used to get it out were of no value. Within three or four months, he had seen some machinery was being sent out for some company or private India, which he was perfectly certain could ne out more than 50 per cent. of the gold in the ore mining in India was not only of importance country, but to all the world, because every ounce wherever obtained, became a circulating medium induced an extra trade, and passed all over the Within the last 25 years, they had seen a fa increase in exports and imports, which had entirely arisen from the vast gold disco in Australia and California. If there had no gold discovered, that trade could not been carried out. It became, therefore, a m of great importance to every country, not only gold should be got out of the ore, but also that as as possible should be got out. Gold mining was of the first enterprises which opened up any country. Without gold mining, California woul have done much, and, certainly, without it, Aus did not make much progress; but the moment gol discovered and worked, other industries followed the country became developed. He did not see what had taken place in Australia and California, not in like manner take place in India. Works be created which did not now exist, which would c further capital, and the country would take a totally start. He was therefore most desirous to see that company which entered into gold mining in India, be, as far as possible, a success. They had to than Powles for a most important statement, which sh that the knowledge of one man might make su where the want of knowledge of the previous made a failure. They wanted men like Mr. P It seemed to him that knowledge could not be obt unless there were some means taken, such as he gested—the formation of a Gold Institute, where be gathered together information from all over the and which could, in its turn, be redistributed al the world.

Mr. Thomson asked what, in the opinion of conversant with the district, was now considered the area of the gold field? This was an importa ment with reference to the great question raised paper, as to the probable great monetary and p effects of the re-discovery of gold. If, as he w formed, it was now certainly 500 miles he wished to know to what extent this field could now be said to extend. If the district of Mysore were included, as well district of Wynaad, would it not be right to s there was a very large territory now fit for Eu habitation. The success which his own compa had in importing Cornish miners, had given h idea that we might have eventually a very larg portion of Cornish men or Australians perm settled in the hill districts of India. If he were there would be a means of very seriously affect future of India in the charge for the army, bec you had a large European colony in the hill d that colony would very easily be attracted still by military service, and you would get a per resident population, which would very much red

"Gold in the East" (London: Strahan & Co.), by Mr. Claremont J. Daniell, B.C.S., of Moradabad, who has treated the question in a masterly and practical manner. In the appendix is an extract from General Ballard, Mint-master at Bombay in *1868. Mr. Samuel Jennings has dealt ably with the relations of gold and currency. (Herapath's Journal,* 4th Dec., 1880.)

fifteen millions now spent annually on the Indian Army. Mr. Lock would very much add to the value of his observations, if he could suggest the best form of machinery. There was no doubt that some of the old-fashioned machinery had been sent out, but to what extent it was so, they would all be glad to learn. The suggestion of a Gold Institute would, he believed, be hailed by all interested in the subject, and the question he should like to ask was, whether something could not be done with the crushed quartz; he believed it contained a large quantity of silica, and it struck him it might be used in some way to advantage in cultivation.

Mr. Maxwell Lyte said the principal cost of treating quartz for gold was the labour. Although he had not been in India, he had read a good deal on the subject, and he should be glad if Mr. Hyde Clarke could inform them a little on the question of labour. The introduction of Cornish miners had been referred to, but he doubted if English labour could be got to work in such a climate.

Mr. Trelawney Saunders said he was not in a position to speak on gold mining, but he might make a remark on the question raised by the previous speaker, namely, the suitability of Wynaad for colonisation by Cornish miners. He could only say he thought it would be very difficult to persuade them to work in a climate which involved a rainfall of something like 200 inches.

A Member said the rainfall all took place in three months.

Mr. Saunders said he did not intend to discuss that question, but there was no doubt that was something like the annual rainfall of the country, which had to be endured, whether it all came in three months or not. He viewed the progress of this speculation with great anxiety. They all knew that the subject of gold mining was not a new one, for it had been under the attention of that Government for the last forty years. So long ago, the investigations made under Lieutenant Nicholson and others were not thought sufficiently encouraging to be proceeded with. At the same time, there could be no doubt that India had produced large quantities of gold; and the most encouraging fact he had heard, if it were a fact, was the result of the removal of a pillar from one of the old workings in one of these Wynaad mines, which was found to be very productive. As to the question of the earlier productiveness of India in gold, there was not much evidence; but there were probabilities, and there were also probabilities of the condition of labour under which gold mining was profitable to the former rulers. Supposing Tippoo Sahib produced large quantities of gold, there could be very little doubt as to the way he would have gone to work. He would have employed large numbers of men under various strenuous directions, regardless of life, or any of those considerations which had to be very carefully attended to by an English Government. Under such conditions, it may have been practicable to remove mountains, or conduct any operations with a greater amount of profit and a less amount of expenditure for labour than would be possible now. The question now was whether the introduction of machinery and the application of European skill would be a substitute for that plethora of labour which a Hindoo conqueror could apply. Perhaps that skill and machinery would be considerably counterbalanced by the large amount of capital with which the interests of the money market and speculators thought it necessary to load every undertaking into which they entered. This was becoming a very serious question, and was one to be regarded by all serious men of business as one of the first importance, and he thought some effort ought to be made in the City of London to put down this ruinous practice, which tended to overload and destroy the profit of any undertaking by the excess of capital imposed upon it. He said this, not with a view of counteracting the operations of these gold-mining companies, for he should be exceedingly thankful for their success, because he could see that if so, they would encourage other operations in other directions, which must greatly tend to the advantage of the people of India, as well as of Europe. He saw already symptoms of the increasing investment of capital in legitimate trade in India; and there was one thing to which we could point with pride in connection with our occupation of that country, that while we took upon ourselves the responsibility of ruling it, we excluded nobody from any good to be got out of it. It was that which gave us a claim to the consideration of other mercantile countries of Europe.

Mr. Christian Mast, as a teacher, hoped that the important question of technical education, in connection with this subject, would not be lost sight of, for there was no doubt that the success of these operations would depend in a large measure on the amount of intellect and investigation brought to bear upon them.

Mr. Dipnall said he came, probably like some others, as a mere learner, and the title of the paper gave no idea of how the subject was going to be treated. Mr. Hyde Clarke had treated it mostly from the productive, and political and social points of view, whilst the map had explained pretty clearly the topography of this particular rediscovery of gold mining; and when he heard the observations of some gentlemen who had spoken, and noticed on that map that the mining operations would be conducted in 10 degrees of north latitude, it showed to his mind that they would be conducted in a climate totally unfit for any great body of Cornish miners or other Englishmen. It struck him, therefore, that they must look either to native labour, or labour imported from China, and that they would not be justified in settling down in such a district a large body of European labourers. He would also suggest that when the rainfall was stated to be occasionally something like 300 inches in the year, or 10 times the average rainfall of this country, even if it fell in three months, the three months of deluge and nine months of arid weather by no means presented a climate suitable for the residence of Englishmen. It was, therefore, of the utmost importance that every possible inquiry should be made before any large number of Englishmen should be introduced there. With regard to the development of gold in India, there could be no doubt whatever, looking at the great mountain ranges, that gold did exist there to a large extent, and that, as in the case of copper and other minerals in ancient Greece, the imperfect manner in which the ores had been treated in former ages had only allowed less than half the products to be got out, leaving a large balance for future generations. They had recently heard from Sir Bartle Frere, that a similar observation applied to the imperfect mode of extraction in South Africa, there being as much left behind as was taken out. Some excellent allusions had been made to the mechanical part of the operations, and the question of improved machinery, but he did not think enough had been said about the chemical part or process, and how, by greater attention to that point, modes of extracting gold might be discovered which would produce it at a much cheaper rate. It struck him, without pretending to any scientific knowledge, that with the wonderful development of electricity going on, modes might be found of fusing gold which had not already been used, and this particular opening in India might present a field of operations, whereby, without the employment of enormous labour, European skill and science might be so directed, as that by a minimum of effort the greatest amount might be produced.

Mr. Andrew Cassels said the last two speakers had forestalled a great deal of what he meant to say. He agreed with the last speaker as to the unsuitableness of

the climate for English labourers, and he also shared the opinion of Mr. Saunders, that this matter had been very much overdone in London lately. He had glanced at the paper before coming, and was much pleased with the impartiality with which Mr. Hyde Clarke had dealt with the subject. What one gentleman had said about the imperfections of much of the machinery sent out was quite true. He had had a great deal of information privately from gentlemen connected with the districts, he had seen many reports and specimens of the quartz sent him, and his strong impression was that there was great disappointment in store for those who had embarked in this enterprise. Although he ventured to say this—and it required some little courage to say it in the face of strong opinions held by many gentlemen for whose opinions he had great respect—no one would be better pleased than himself if these golden dreams were realised. He greatly approved of the sentiment in the latter part of the paper, where the writer spoke of the effect of the great discoveries of gold upon India and on the exchanges, matters which had come home to most of those connected with India lately with startling effect. To speculate on what would be the result of large discoveries of gold, was at present scarcely possible. The great fluctuations they had seen in the last 12 or 15 years, in the value of silver, taught one to be cautious. Fifteen or sixteen years ago, there was a great agitation in India, chiefly originated by his brother, Mr. Walter Cassels, in Bombay, and by Sir William Mansfield, with regard to the introduction of a gold currency. Their arguments were, at that time, chiefly founded upon the fact that silver was scarce, being then 63d. per ounce, instead of 51d., as at present. They wished to introduce a gold currency, and he himself held much the same opinion. In that room, he read a paper bearing upon the subject, but since then silver had fallen so much in value that it was impossible to say what would happen. Let them see what the gold discoveries, and the result of the conference to be held in Paris in next April, would do for silver. It was pretty clear something would be done, and he indulged the hope that they would see silver regain some of its old value, and not remain, as at present, a great loss to the Indian revenue, and to every man toiling in India under a broiling sun, and the wife and children at home, to whom he had to forward a considerable portion of his earnings. There would be no greater benefit to Englishmen connected with India than to see some improvement in that respect.

Mr. Woolley said he was well acquainted with the district, and had some knowledge of gold mining, having visited other gold countries. He begged, with all possible respect to Mr. Hyde Clarke, to say that in this case the companies which had been formed had commenced, not by sending out the machinery, but by providing themselves with raw material. No doubt they had done it to an extent which perhaps in private life would bring them to bankruptcy, but the greater part of the capital which had been raised had been sunk, not in machinery, but in providing the raw material upon which they must operate, and from which they hoped to extract satisfactory results. As far as his own opinion went, if skill were brought to bear, the results would far exceed anything ever seen in Australia and California, but it all depended upon that. There was, therefore, every requisite. One of the gentlemen had spoken about rainfall, but he was in India last year, and the rainfall, instead of being 300 inches, or even 200, did not average 100 inches; 200 was quite the maximum. And the Cornish miners, even if they were there, would only be exposed to the rain during their passage from their quarters to the works. He quite agreed that to send any quantity of English labourers to 10 degrees north latitude would be an *absurdity, for* the climate was unsuitable to a European *working out of doors*. But those who worked the mines would not be out of doors, and would not b[e exposed to] the sun. There was, however, no great nec[essity for] Cornish miners there. There was every c[...] first-class labour to be had on the spot; [...] industry, as far as it had gone, had [...] the price of labour at all. If it ha[d, it would] have affected his pocket, as a large co[...] The supply of labour was almost inexh[austible;] there were great muscular fellows there [...] capable of doing any amount of work, s[...] miners almost by birth, who were ready [...] or 7½d. a day, without the slightest hesit[ation. All] one wanted of Cornish miners, was the s[...] intend this labour and, bring it to bear i[n such a way] as to produce satisfactory results, and th[...] such skilled labour need not be much. A[s to the] area, he believed that at present the [...] area of the colony of Victoria was 1,4[...] square miles, whilst the known aurife[rous area of] Wynaad alone was twice that. The [...] Victoria had, two years ago, over 800 mini[ng companies] in operation, and in India we had now 2[...] utmost, 25 on twice the area. How cou[ld it be said] then that the companies were too many, [...] were almost certain to come to grief. T[here was no] prospect of such a thing, if only proper ski[ll and intelli]gence were brought to bear.

The Chairman said he would not detain [them] long, because the several gentlemen who h[ad discussed the] subject had pretty nearly exhausted it, but [he would] confine himself to two or three practical [points. First] was the area of possible gold-field. He c[...] self speak on the area along the Eastern G[hauts ...] fields seemed to exist in the Ghauts on bo[th sides of the] peninsula. The Mysore gold-fields were [...] the verge of the Eastern Ghauts. The W[estern Ghauts] he knew much better, having been conne[cted with that] country since 1842, and knowing it all v[ery well. He] noticed what Mr. Brough Smyth said t[...] to the effect that not one-twentieth pa[rt of the] gold area had been prospected in any d[...] were some gold washing in streams and r[...] all along the ghauts in Canara, and ri[...] whole way, almost to Cape Comorin, b[...] they might accept it, that for the present [...] that part of Wynaad now attracting [...] continue to be the nucleus of the work[...] question, doubtless, was a very importan[t one. Mr.] Woolley, whom he knew to be a practic[al ...] labour in Wynaad, had given some ve[ry] encouraging facts as to the present co[ndition of the] labour market, but what would be the e[ffect of the] development of the gold industry besi[de other] industry, was very uncertain. In the m[ean time there] was no doubt that the gold industry start[ed on the West] Coast of India, as respects labour, in pro[...] better position than in any other countr[y ...] You started with a teeming population, w[hich] would afford all the labour which would b[e required at] the present. Wages, however, would r[...] be taken into account. Within the tim[e he had been] in India, the price of labour had cert[ainly ...] and a large increase in the demand must [have an] effect upon it. He was glad Mr. Cass[els had called] special attention to the caution required i[n ...] this question, and he himself felt some a[...] fact that the companies were going ou[t ...] handicapped by the large prices paid [...] regards the climate and the employm[ent of European] labour, he thought that, beyond the s[...] quired, the importation of large numbe[rs ...] would not be requisite or desirable. [He would not] follow Mr. Hyde Clarke into the interest[ing question of] coinage and exchanges in India. He en[tertained] doubts whether a poor country like I[ndia] could practically use a gold coinage fo[r ...] come. One fourth part of the populati[on ...]

was practically bartering grain they raised or l for such commodities as they used, or used shells per as tokens; the country was a very poor one, e doubted whether, being in such a condition, it float a gold coinage. Any way, as Mr. Clarke said, they would have to mint the gold in some or other, and then it would be practically decided her such a coinage would be a useful form of her currency. He observed that the proper align- t of the connection between the Wynaad and the ay system of South India lies through the Mudel- (Moyar valley) district, and thence *viâ* Bandipur Mysore and Bangalori, whence was derived the ly of grain and labour, and not over the Nilgherry with the Coembatore district by the Kunur valley. so-called Alpine railway up the latter valley would a snare and delusion.

Hyde Clarke said the necessity for a reply was much less than it appeared, because several of the raised had been already dealt with by him in his as would be seen on its perusal. Beyond that, necessity of his giving a detailed reply was d by the nature of the discussion, and he ted at the outset, that he was much more to have the benefit of this discussion, than forward any views of his own. It had been advantage, not only that they had men taking it, well acquainted with India, and deeply d in it, but men of very wide experience in arts of the world. In fact, there was hardly a d region which was not represented there in ssion, or by the presence of some one practically d with it. Mr. Woolley, to a great degree, ered some of the other speakers, but he thought ley had misunderstood him on one or two points, when they came to compare notes, they would d in substantial agreement. There was no question of the employment of a large f European labour. The great advantage of Indian region was that it had a large supply , but at the same time they did want skilled Some gentlemen seemed to think it was im- for a Cornishman to go to a country of that ure, or one which had a large rainfall. But ll was a very great advantage to gold working; reference to the climate, he would remind t Cornish miners went to very much worse than India. Some of Mr. Woolley's neigh- the Wynaad, although that was an unhealthy had remained the whole of the year on their ntations, so that it could not be altogether so nate. They must, however, recollect that the s not going to work on the surface, but under r in case of reduction operations, under shelter; s by no means necessary he should be exposed l periods of the year. In such cases the white unacclimatised, went somewhere else, and it was advantage in this case that there were some lthy districts in the Neilgherry hills where go. On a careful and candid consideration paper and the discussion, he thought the rt of the objections would be removed. els had brought forward many important facts must not be left out of consideration. He they would all see changes in the relative of silver, and what Mr. Cassels had said to him a reason why they should look at this encouragingly and not distrustfully. In the e had been careful not to encourage share on, but at the same time to ask them to look at bility of practical results being obtained. He ther go by the experience of those practical men present, and who knew what the resources of the re, than of the suggestion of a mere doubter. own part, he looked upon it that disastrous n would take place; but they had no duty, for f gamblers who chose to put their stakes on the table, to stop legitimate operations. Why were they to protect men who had gone in for gambling? The present condition of the share market, with regard to Indian gold companies, in his firm belief, was nothing to what they would yet see. For two years he had foreseen that in all likelihood there would be a gold mania, and that speculation would take the form of gold mining. If so, they would see reproduced what they had seen before, these shares would run up to fabulous premiums; but what had that to do with gold mining? They could not prevent such a thing. These men were gambling with counters; men were putting their money into gold mining shares who would stake their money on the Derby, and were they to protect them in either case? Why should they stop the whole operations of the empire for the sake of persons of that kind. What they had to look to were the persons really interested—the population of India, whose welfare was at stake. One point referred to by Mr. Lock and himself was the effect produced on a district by the introduction of mining machinery. To illustrate that, in the *St. James's Gazette* of that evening, there was a paragraph with regard to the Linares lead district in Spain. It was stated that in consequence of the great increase of lead mining, the Belgian manufacturers had supplied a large amount of machinery, the result of which had been that they had been called upon to supply machinery likewise, for the oil industry of the district, and the people there were giving up the old clumsy wooden presses, adopting improved machinery, and turning out a better article in olive oil. That supported what he had stated in the paper, that they should be justified in looking at the collateral advantages which would undoubtedly arise, apart from any mining results. The evidence of practical men showed that there was a great gold region in Southern India, and nothing but the grossest imbecility could prevent very large results being obtained.

The Chairman moved a vote of thanks to Mr. Hyde Clarke, which was carried unanimously.

Some specimens of gold were kindly lent for exhibition at the meeting by the Wynaad Company, Professor Tennant, and Mr. Bryce Wright.

ELEVENTH ORDINARY MEETING.

Wednesday, February 16th, 1881; W. H. HALL in the chair.

The following candidates were proposed for election as members of the Society:—

Branston, F. R. E., 23, St. Swithin's-lane, E.C., and 66, Lillieshall-road, S.W.
Dollman, Charles, 293, Clapham-road, S.W.
Greenwood, A., LL.D., Flaxfield College, Basingstoke.
MacCallum, Andrew, 47, Bedford-gardens, Kensington, W.
Wilding, Samuel P., 23, Rood-lane, E.C.

The following candidates were balloted for, and duly elected members of the Society:—

Bridge, John, F.R.G.S., Marlborough-house, Sale, near Manchester.
Cochrane, Vice-Admiral the Hon. Arthur A., C.B., United Service Club, S.W.
Collingwood, Lieut. William, The Limes, Cheshunt, Herts, and India-office, S.W.
Fisher, John, 43, Mincing-lane, E.C.
Hall, William Shippery, 79, Cannon-street, E.C.
Haslam, Alfred Seale, Duffield-road, Derby.
Helder, Augustus, Corkicle, Whitehaven.

The Chairman, in introducing Mr. Taylor, said his only title to preside was his having had the good for-

tune to bring to light afresh the most remarkable instance of industrial partnerships—that of Mr. Leclaire, on which a pamphlet, written by him, had just been published by the Co-operative Wholesale Society. The remarkable feature of that enterprise was that, nearly 10 years after the founder's death, it still went on in a more flourishing way than ever. It was the whole object of Leclaire's life that the scheme should not be dependent upon him, and, during the latter part of his life, he withdrew as much as possible from the active supervision of the business. The success had been most wonderful, and the same principle had been followed in several other instances on the Continent; but, unfortunately, in England such attempts had not hitherto turned out well. Many might remember the attempts of Messrs. Briggs, Messrs. Fox, Head, & Co., and others, but they had not the elements of durability. Why this should be so, he was at a loss to understand, because the system was one which eminently commended itself to common sense or enlightened self-interest. Leclaire began life as a labourer, and noticed the wasteful habits of labourers. As he got on in life, and became an employer himself, he asked himself the question if nothing could be done to remedy this state of things, and came to the conclusion that the only way was to give the workmen themselves an interest in greater thrift, carefulness, and industry. He thought that if 6d. a day was saved in this way, and the workmen received 1½d. of it, and the employer 4½d., the plan could be adopted, and this proved to be the case. In this way a large fund was accumulated out of nothing. He had a suspicion that one cause of the non-success of the plan in England, was the opposition of trades unions. These organisations had done great good in some respects, but he feared that in some cases they had opposed enterprises of this kind, which had been essayed by men not in the union, and of which the union leaders were jealous, because they were not concerned in it themselves. He threw out the hint that this might be the cause, because he knew that in France, employers came more directly in contact with their workpeople.

The paper read was on—

THE PARTICIPATION OF LABOUR IN THE PROFITS OF ENTERPRISE.

By Sedley Taylor, M.A.,

Late Fellow of Trinity College, Cambridge.

I ask attention this evening to a particular method of remunerating labour, which has for some time been practised in a large number of important industrial and commercial establishments, situated for the most part in France, Switzerland, and Germany. If any justification is needed for bringing this subject before the Society of Arts, I find it in the following considerations:—The relations between employers and employed, under the system of payment by fixed wages only, are admitted on all hands to be unsatisfactory. They involve a chronic antagonism, breaking out periodically into internecine conflicts, which leave few tangible results behind them, save extreme mutual exasperation. One is reminded of the old school-game of French and English, where a great expenditure of force in tugging at the opposite ends of a rope has for chief result a marked rise of temperature, where in fact, as in an ill-constructed machine, energy is converted mainly into heat.

The evil of a permanent antagonism between men engaged in one and the same branch of production or distribution, has induced a number of employers to try whether by modifying the established method of remuneration by w[...] only, they could bring about a better sta[...] things. The bulk of these experiments [...] been made on the Continent, and, though [...] without examples of failure, they present, [...] whole, a very decided and very encou[...] success. This being so, the close con[...] which links together the industries of neig[...] ing countries makes it incumbent on [...] employers to bestow vigilant attention on [...] of such importance as a considerable con[...] movement towards a reform in the mode [...] munerating labour.

While, however, I feel that the nature [...] subject is its own best justification, I am per[...] aware that one who, like myself, is no emp[...] of labour, and, consequently, has no profit[...] divide, may, when he urges such division [...] those who have, be damagingly compared [...] certain hearer of a charity sermon, who, [...] cording to Sidney Smith, found his gene[...] emotions so stirred by the eloquence of [...] preacher, that he put his hands into his ne[...] bour's pockets, and was thus enabled to place a l[...] liberal contribution in the plate. In order to [...] the point of this dangerous comparison, I [...] without professing an impartiality which I d[...] feel, endeavour, as far as possible, to set ou[...] facts on which I rely, in the statements, ofte[...] the actual words, of employers describing th[...] sults of experiments which they have thems[...] made. By placing before you their statemen[...] the most authentic and least warped form [...] command, I hope in some measure to make [...] my own lack of business knowledge and bu[...] experience.

The mode of remunerating labour which i[...] to engage our attention consists in assigni[...] the employed, over and above their wages pa[...] the ordinary market rate, a part of the net p[...] realized by the concern for which they work. [...] system is known in France as "*la partici[...] aux bénéfices*," *i.e.*, participation in profit[...] shall, for shortness's sake, designate it in thi[...] simply as "participation."

The economic basis on which the method [...] may be thus stated:—The profits realised b[...] industrial establishment must largely depe[...] the degree of vigour and vigilance with whi[...] hands in its employ perform their work. Eco[...] of time, and avoidance of needless consumpti[...] raw materials and destruction of tools [...] machinery, will lead to higher profits tha[...] accrue where dawdling, waste of materials, [...] recklessness in handling implements and ge[...] the order of the day. Now, the established [...] tice of the workshop shows that, under the [...] of payment by wages alone, it is not expecte[...] this zealously active type of work will be [...] voluntarily. Watchers and overlookers are p[...] there, in order to extort, by the fear of dis[...] whatever quantity and quality of work is o[...] able by an appeal to such feelings.

Work thus reluctantly yielded will, manifest[...] inferior at all points to that given volunt[...] It will therefore be dear work, and tend to d[...] profits, which will be further preyed upon b[...] wages of the overlookers employed in exacti[...] in other words, by the "costs of superintend[...] which it entails. The expectation of thos[...]

d participation was that, under that work of the most zealous kind would be ously given, when once the workmen had fully alive to the fact that their more efforts would directly benefit themselves. tter, and therefore cheaper, work would be l, and the costs of supervision be propor- y reduced. It is in the additional profits to ed by these stimulated efforts, and in the y in superintendence which they render , that participation finds the fund which it s to divide. The employer is, therefore, ld upon to forego any portion of the profits would, under a non-participating system, rued to him.

ard to the manner in which the work- are in profits is made available by them, ist among participating houses very wide s of practice; indeed, these differences convenient means of classifying such They fall into three categories :—

e which pay over the workmen's share ual ready-money bonus.

which retain that share for an assigned order ultimately to apply it, together ccumulated interest, for the workmen's

which annually distribute a portion of en's share, and invest the remainder.

e to take one establishment out of each a type-specimen. It will be readily that limits of time will compel me to heir organization only in the most ms.

d to the sources from which my state- ct will be drawn, I can here only name the chief. These are :—(1) A German lished in 1878, by Professor Böhmert, , under the title "Die Gewinnbetheili- "Division of Profits." (2) The peri- tin† of a French society, formed in 1879, ting the practical study of participa-) the work of M. Fougerousse, "Patrons de Paris,"‡ "Masters and Men in Paris," n 1880.

preliminaries, I begin with the group which hand over the workmen's entire ofits in annual ready-money bonuses. I pe-specimen the establishment of M. noforte maker, 64, rue des Poissonniers, articipation has existed in that house on the following basis :—At each annual , interest at 10 per cent. on the capital the business is deducted and handed proprietor, M. Bord. The remaining are then divided into two parts, res- proportional, the one to the interest otted to capital, the other to the whole hich has been paid during the year in the current market rate. The former ded to M. Bord's receipts; the latter is nong all such workmen as have been by the house for not less than six months in question. The individual distribu- place in bonuses proportional to the yearly ctively earned by each workman in wages. dends to labour are handed over with- mitation or condition whatever. The number of *employés* was, on January 1, 1878, 6 clerks, 395 men, and 27 boys. The sums thus paid during the last three years were, I am informed by M. Bord, in 1878, £3,784; in 1879, £2,874; and in 1880, £3,548. They represent, respectively, 15 per cent., 12 per cent., and 16 per cent. on the men's yearly earnings in wages. The entire amount paid over, exclusively out of profits, since the introduction of participation in 1865, is £39,300. M. Bord considers the effect of the system, in attaching the workmen to the house, and its influence on their relations towards their employer, to be extremely satisfactory. In June, 1869, he ascertained that about one-half of his workmen had invested their dividends for that year, and that about a quarter had employed them in clearing off debts, and in purchasing clothes and furniture. A dozen or so only had dissipated a part of their dividends.

The number of houses which adopt M. Bord's system of immediate cash distribution is very small. I pass to a larger group, organized on a very different plan. The example selected is a leading Parisian Insurance Company, the Compagnie d'Assurances Générales, 87, rue de Richelieu.

In this company, whose staff of officials, clerks, and other *employés* numbers about 250 persons, participation is now of thirty years' standing. It is fixed at 5 per cent. on the profits of the company, and allotted in proportion to the individual salaries earned, which are at least on a level with those obtainable in non-participating companies of the same kind. The essential feature of the system here in force is that no part of an *employé's* share in profits is paid over to him in ready money. The sums to which he becomes yearly entitled are placed in a deposit-account opened in his name, where they accumulate at 4 per cent. compound interest. Only on the completion of 25 years of work in the house, or of 65 years of age, can the beneficiary claim the liquidation of his account. The following alternatives are then at his choice :— He may purchase a life-annuity in the company's office, with reversion to his widow or some other person to be approved by the Board of Directors; or he may invest in French Government or railway securities, in which case the stock certificates will be retained by the company until his death, in order to be subsequently handed over to the persons whom he may designate by will as his heirs. He cannot claim the payment of his account in ready money, the Board of Directors being sole judges of the exceptional circumstances under which they may consent to such payment, and not bound to assign any reason for their decision.

M. Alfred de Courcy, to whom the Compagnie d'Assurances Générales, of which he is the managing director, owes this particular form of long-deferred, indeed, one may say, of testamentarily transmitted, participation, has publicly advocated it with great eloquence and ability. He insists on the relatively large sums which it has accumulated, in comparatively short spaces of time, for *employés* of the company. Thus he specifies a simple bookkeeper, in whose name £480 stood to the good after fourteen years of work, a sub-cashier with more than £800 after 25 years, and a superior official with £2,600 at the end of a similar period. The results to the company itself are described in the following passage, which I

ckhaus. † Paris, Chaix. ‡ Paris, Chaix.

translate at second hand, from the German version of the original given by Böhmert:—

"The bond which unites the company and its *employés* has acquired a peculiar strength. Formerly, notices of resignation were very numerous. Among the young people, caprice, levity, and infirmity of purpose were often the cause of this. On the occurrence of the slightest annoyance they became intractable, and withdrew, or worked negligently, while they were looking about for another post. In the case of the more practised and experienced *employés*, personal interest was the decisive motive. New insurance companies were called into existence, the founders of which naturally sought for people who were not novices, and possessed special acquaintance with our business. Where were such men to be found, unless in the staffs of the old insurance companies? We, therefore, frequently had our best *employés* carried off by the promise of a higher remuneration, in order that they might make use elsewhere of the knowledge acquired with us, so that we actually furnished the weapons for a competition directed against ourselves. To this disorder, and this withdrawal of *employés*, which threatened to injure our organization, the deposit-account has put an end. It is so highly valued, that the sacrifice of the benefits of participation for a momentary advantage is not readily made. It has rendered even the young people more steady and assiduous. The faithful *employés*, too, have become more hardworking, not merely because they know that they have a joint interest in the success of the business, but because it is an advantage for them that the number of the staff should not be increased. At the time of heavy pressure of business they are, therefore, willing to redouble their activity, and, if necessary, to stay over-hours at the office. Their own interest is the best guarantee for their zeal. The limitation of the number of *employés* to what is adequate, and no more, is an important source of saving to the company."

M. de Courcy is so high an authority on all matters connected with participation that I desired, for the purposes of this Paper, to ascertain his latest view on the subject. I accordingly asked him to tell me whether his opinion, both of the principle of participation itself, and of the system of deferred possession, remained as favourable as at the time of the publication of Professor Böhmert's work. In his reply, dated November 6, 1880, M. de Courcy writes as follows:—

"My present opinion is more favourable than ever, both to the principle of participation, and in particular to my system of deferred possession. The institution has now had thirty years of experience, that is to say, of unvarying successes. Each year, by augmenting the account of the *employé*, makes him feel more strongly the advantage of the deferred participation. Each year, too, the company appreciates better what it gains in fidelity in return for these sacrifices. My general principle is that there are no thoroughly satisfactory business transactions except those which are satisfactory to both the parties concerned. Experience has justified our institution from each of these points of view. It is excellent for the *employés* and excellent for the company."

The great majority of participating houses have favoured neither the entire immediate distribution of profits practised by M. Bord, nor the extremely remote postponement of benefits advocated by M. de Courcy. They have adopted a mixed system, by conceding to the workman immediate possession of a part of his share in profits, and investing the remainder for his future benefit. Of the establishments which have taken this course, I select as example the great railway printing, publishing, and bookselling ho[...] M. A. Chaix, 20, rue Bergère, Paris, who once the "Bradshaw" and the "Right H[...] H. Smith" of France, and who employs 600 persons of both sexes. Participation from 1872, and extends to all well-con[...] hands who can show three years of cont[...] presence in the house. The share assig[...] them is separately fixed each year, but has [...] been 15 per cent. on the net profits. T[...] allotted to each participant, which is prop[...] to his or her annual earning in wages, is [...] into three equal parts. One of these is [...] over on the spot in cash; a second, [...] regarded as the property of the recipient, [...] in the custody of the house, in order to ai[...] porting its provident society; the remaini[...] is likewise placed to the credit of the bene[...] but only comes into his possession at the [...] sixty, or after twenty years of uninterrupted [...] for the house.

In regard to the ultimate disposal of the secon[...] third parts, regulations subsist similar to th[...] force in the Compagnie d'Assurances Généra[...]

The total amount allotted by M. Chaix [...] profits to his participants, from 1872 to 1[...] £14,409, which represents an annual ave[...] $7\frac{1}{2}$ per cent. on the wages of the beneficiaries [...] one-third of this average, *i.e.*, $2\frac{1}{2}$ per cent. on [...] was, however, as has been already exp[...] yearly distributed in ready money. In reg[...] the general results of participation in this [...] we have the testimony of M. Chaix himself, [...] addresses which he has delivered to his parti[...] at each of the seven yearly distributions whi[...] as yet taken place.

I will translate a few extracts from these, [...] speak for themselves.

At the second participation, on April [...] M. Chaix said—

"I have ascertained with satisfaction that th[...] duction of participation has, as I hoped it wo[...] developed the zeal of those interested in it; ea[...] takes more interest in the work assigned to hi[...] executes it better and more expeditiously."*

On March 28, 1875, he spoke as follows:–

"If there be a spectacle which should sati[...] friends of social peace, it is assuredly that prese[...] the industrial family of this establishment, when [...] completion of the year's work, it is gathered t[...] in order to learn the results of its own allotted s[...] the profits realised. No institution is, indeed, [...] adapted to draw close the bonds which unite yo[...] house, and to inspire you with confidence in the [...] than the participation which has enabled me to co[...] for your benefit, not only certain immediate adva[...] but also an economized capital, which has, fo[...] among you, already reached important dimensio[...]

The address of April 13, 1879, contai[...] following passage:—

"In what concerns the execution of work [...] workshops and in the offices, I find around me [...] amount of willing zeal, that I give the main cr[...] this excellent state of things to participation, a[...] gratulate myself more and more on having [...] principle working in the house."‡

* Comptes Rendus des Assemblées Générales Annuelles, [...] Chaix, 1880, p. 33.

† *Ib.*, pp. 39 and 40.

‡ *Ib.*, p. 73.

three categories, of each of which an e has now been given, include all houses ng what has been termed simple participa- .e., that under which the participants are d no voice in the administration of the con- r which they work, and own no part of the l embarked in it. There are, however, a few s which admit their workpeople to part- ship in capital, and to a share in administra- ntrol. These establishments are specially ting, not only on account of their individual tance, but because their organization may be ded as marking the point of transition from participation, where the master retains ex- e possession of capital and control over it, to co-operative production, where the apital belongs to the associated workmen, e business-direction is in the hands of a r or committee acting under their au- Each of the small group of houses g this intermediate position is well of special study, but where, as this but one of them can be described, on Leclaire, at Paris, is incontestably to be selected as the representative of . It is a house-painting and decorating ment, 11, rue Saint-Georges, and em- present upwards of one thousand work- founder, born in 1801, the son of a poor emaker, and apprenticed in 1818 to a house-painter, had, by 1834, already at- sition of distinction and assured success loyer of labour in that branch. From rds, he practised participation in profits, with his steadiest and best-conducted and gradually extending the system others. In 1853, Leclaire established, rkpeople, a "Mutual Aid Society," to be exclusively out of the profits of his his society which, until 1860, only per- e functions of an ordinary sick-club, thenceforth to supply retiring life- its members on their superannuation e work. In 1864, the same society was, and irrevocable deed, constituted sleep- r in the house, and owner of a consider- on of its capital. Five years later, in aire took the final step of transforming ishment into a permanent industrial n, the net profits of which, after deduc- er cent. interest on capital, were to be lisposed of in the following proportions: urth was to go to the two managing who were at first to be M. Leclaire d his associate, M. Defournaux. One to be distributed in ready-money to labour, and the remaining quarter to l over to the Provident Society for its d pension fund. The business-direction use, *i.e.*, its actual executive, was to xclusively in the hands of the two partners for the time being. To the ers of the Foundation were, however, ery considerable powers, to be exercised through two committees, one for the the other for the "Society," on both abour would have a predominant repre- These two bodies, with their electing cies, were to choose the managing nd foremen, admit new members, expel grave misdemeanants, administer the funds of the "Society," and see that the share of profits annually due to it from the "House" was fully paid over.

Leclaire did not long survive the definitive incorporation of his house. He died in 1872, and in 1875 death removed his successor, M. Defournaux. The present heads of the establishment are MM. Redouly et Marquot, the latter of whom was private secretary to Leclaire. M. Charles Robert, *conseiller d'état* under the Empire, who from his boyhood was strongly attached to the founder, succeeded him as President of the Mutual Aid Society, and, though now charged, as managing director of a great Parisian Insurance Company, l'Union, with engrossing administrative work of his own, has never ceased to be the staunch and untiring friend and counsellor of the Maison Leclaire; advocating its central principle with a ready pen, and standing forth, with eloquent tongue and cultured utterance, as its mouthpiece on every occasion of corporate weal or woe, whether to cheer on its members with the good news of continued and increasing prosperity, or to pronounce in their name, as they crowded in hundreds around him, words of final leave-taking at the open graves of Leclaire and Defournaux.

The material successes achieved by the house during the last ten years have been little short of marvellous. The sum paid each year in wages has increased during that period from £16,257 to £34,715; the sum annually paid in labour-dividends out of profits has risen during the same period from £2,331 to £6,400. In other words, the yearly payments in wages are now double, and the workmen's ready-money receipts out of profits nearly treble, what they were ten years ago. Each individual participant received, at the distribution made last summer, more than 18 per cent. on his year's wages.

Independently of these annual immediate advantages, the Mutual Aid Society assures to each of its members, besides all the benefits of an ordinary Friendly Society, a life-pension of £40 per annum from his fiftieth year of age and twentieth year of work in the house, half of which is continued to his widow for her life. It further pays over an additional £40 in cash at his death to his survivors, and, if he is disabled or killed while on actual duty, pensions him off with the full life annuity of £40, or his widow with a half-pension of £20, and that however short may have been his period of service in the house. The purely economic results of participation in the Maison Leclaire may be summed up by saying that the total of payments out of profits to the participating workmen, since 1842, whether made in ready money or to the account of the Mutual Aid Society, has now reached the sum of £94,700.

I wish the time at my command permitted me to describe, even in the briefest terms, the high educational and moral benefits flowing from the administrative and social institutions which Leclaire grouped around the central principle of his Foundation. I abstain, however, with the less reluctance, inasmuch as a somewhat full account of these institutions is to be found in the *Nineteenth Century* for September, 1880.

The principle of participation, organized under a

great variety of different forms adapted to differing industrial conditions, has been applied with success to almost every class of undertaking, productive, distributive, or purely administrative. In order to give an idea how large is the extent of ground covered by these applications, I will refer, very summarily, to a few leading categories.

In agriculture, undertakings on a participatory basis are being successfully carried on by Herr Von Thünen in Mecklenburg, by Herr Neumann in East Prussia, and by Baron Zytphen-Adeler in the Danish island, Zealand.

In production on a considerable scale, I may cite the paper-mills of M. Laroche-Joubert, at Angoulême, which employ 1,500 workmen; the Maison Leclaire, with its 1,000 or 1,100 painters and decorators; and the cotton-mills of Steinheil et Compagnie, at Rothau, in Alsace, which give employment to some 600 men.

Of productive establishments working on a smaller scale, a conspicuously successful example is the firm Billon et Isaac, at Geneva, which manufactures parts of the mechanism of musical-boxes, and employs about 100 workmen.

Under distribution, a leading house is the Magazin "au bon marché" at Paris, property of Madame Veuve Boucicaut, a huge establishment for the sale of manufactured articles of all kinds, which allots a share in profits to about 300 out of the 1,600 persons whom it employs. There are, especially in Paris, very many smaller participating establishments, in different branches of distribution, which it is needless to refer to by name here. In order, however, not to pass over the purely administrative undertakings, I may instance the bank of Vernes et Compagnie at Paris, and a whole group of insurance companies in the French metropolis, including, beside the Compagnie d'Assurances Générales already referred to at some length in this paper, l'Urbaine, l'Aigle et le Soleil, la France, la Nationale, and l'Union.

The whole number of establishment now at work on the Continent upon a participatory basis, does not admit of exact determination, but is certainly not less than one hundred.

I have as yet mentioned cases of successful participation only, and an earlier reference may have been expected to the abortive attempts which have occured on the Continent side by side with the prosperous experiments described above. In particular, I may be fairly asked to explain why I have said nothing about conspicuous English experiments, which have ended in the abandonment of the system. Now, assuredly, it has been from no desire to blink discussion of the English cases that I have abstained from entering upon them here. On the contrary, I think that instances of failure are often precisely those which best deserve and reward a searching discussion.

In order, however, that such a discussion may take place to any good purpose, it is an obviously essential preliminary that the facts on which the failure turned be publicly accessible, in detailed statements of recognised authenticity. In regard to the unsuccessful English experiments, this condition has not been satisfied. The circumstances which brought about the abandonment of the attempt have formed the subject of no detailed and authoritative public statement. As far, indeed, as concerns one of the most important and best known unsuccessful English experi that made from 1865 to 1874 in the collie Messrs. Briggs, at Whitwood, I have rea believe that a statement as to the causes failure is likely before long to be fortho under the authority of Mr. Henry Currer At present, however, the basis for a decisi cussion of the abandoned English atte non-existent. With regard to the con break-downs, we are, thanks to Böhm search, in a better position for forming a ju Lack of time alone prevents my entering these cases, in respect to many of w failure can be decisively traced to ca traneous to the principle of participation.

I have now, far more fragmentarily, inde I could have wished, described the main f of participation as practised on the Contine remains to say a few words on the system and on its applicability to English circums The theory on which it is based—a theory dantly verified by experience—is that, by d interesting workmen in the fruits of ente better and more economical labour will be ob and thus a source of additional profits These surplus profits might, indeed, with justice, be allotted wholly to the workmen stimulated efforts produced them. In p however, a share goes to the employer, wh so pleases, may, by investing it in a reserv protect himself against losses in bad years. thus clear that participating workmen do indirect but perfectly real way, share losses as profits with their employers. This i denied by opponents of the system; it is, th important that the fact should be explicitly and made good.

In regard to the final disposal of the wo share in profits, it will not have escaped not all but diametrically opposed to each other Bord's system of annual cash distribution de Courcy's method of long-deferred possessi the merits of these rival systems an eager dis took place before the Société d'Economie at Paris, in April last.* A question on wh such authorities as M. Fougerousse and Courcy are not agreed, and which a majo houses has rather compromised than decided even inexperience free to utter its opinion. therefore, venture to say that the system mediate cash distribution seems to me alo sistent with the economical theory on participation rests. The workman's sh profits is earned by his own more efficient and, from the moment of its definitive rea and ascertainment, becomes rightfully his. therefore, be temporarily withheld from one ground only, that, in his own interest, that of the community, he ought to be d from the free disposal of his own earnings.

I cannot believe that, among the stea energetic class of workmen, with whom al ticipatory experiments should, at least at attempted, there is any necessity for such a restrictions. The greatest pains should und be taken to bring forcibly before them, at of the annual division of profits, the extr

* "Bulletin de la Société Internationale d'Economi Paris, 2, Rue Perrault, 1880. Tome vii., pp. 165-186.

of systematic and persevering investment. final decision ought, I think, to be left to 10 can probably decide better what is for n interest than other people can settle it n. As far as English workmen are con- there can be little doubt that the strong of independence which the influence of ocieties has fostered among them, would the compulsory detention of sums actually extremely unwelcome, even if it did not, as it very possibly might, render such deten- practicable.

ipation, successfully practised under what- m, confers, as has been seen, signal advan a both the parties directly concerned in it. employer it gives increased security and al peace. For the thrifty workman it ac- tes, not by the hand of charity, but as the f his own heartier efforts, an economized which he may employ in making his old y and independent, or, better still, trans- art at least, to his children. Further, f even higher significance, it brings to the an enhanced feeling of respect for him- or his fellows, based on the fact that he have become, in a very real sense, n the house for which they toil.

d be an oversight if I omitted to point he advantage which the public too, in its of consumer, derives from the system Participation encourages excellence of hip, and combats every form of trade with singularly efficacious vigour. The sity of the complaints so constantly made crastinating, scamped, ungenuine work under existing industrial arrangements, re of the benefits to the consumer to be from a system under which these evils re considerations of self-interest if on no ound, sternly discountenanced by the themselves.

now only to ask, in conclusion, whether y valid reason why a system which has fruitful in good results on the Continent be hopefully re-introduced into this In order to answer this question, we to take two preliminary steps; to set conomic conditions under which a par- success is attainable, and to examine hose conditions can, or can not, be satisfied d.

r that participation may be advan- introduced in any particular branch of the workmen must have it in their power, fficacious labour, to increase the quantity, the quality, or diminish the cost price, ple of production in that branch. The which these results are attainable—the which manual labour can thus exert upon n—must necessarily be different in dif- lustries. Much will depend on whether ials employed are cheap or costly, and on machinery plays a subordinate or a pre part in the production. The degree in ts of labour-superintendence admit of ood, is also an important element of the A promising field is, therefore, mani- sented by such industries as house-paint- ring, glazing, plumbing, &c., in which abour plays the predominant part, and individual superintendence is well-nigh impractic- able, and where no one will have the hardihood to assert that the workmanship is already of so zealously active a type that its excellence is un- susceptible of further improvement. Much the same may be said of agriculture. In coal-mining, as I am assured by the most competent witnesses, there occurs a huge waste of materials, due solely to the fact that the colliers have no interest in pre- venting it. Even in machine-dominated industries, the vigilant attention with which a really zealous operative superintends the instruments under his charge has a surprising influence on the final result. Mr. Kenward, the very able manager of the lighthouse department of Messrs. Chance's glass-works, near Birmingham, where the pre- valence of piece-work supplies a direct gauge of the results attained by individual effort, assured me that, in such an apparently routine occupation as superintending a machine punching holes in a metal plate, a thoroughly active workman could realize a surplus wage three times as great as that obtained under identical conditions by a less strenuous, but not less skilful or less capable, col- league. At a meeting in Birmingham, attended by representative artizans, it was asserted without contradiction, by an exceptionally well-informed man, that "an enormous preventible waste oc- curred in every trade in the town."

It would appear, from the above considerations, that there is no lack of scope for participatory successes in many branches of English industry. The question may, however, be raised—Can our workmen be brought to recognize the benefits of participation, and put forth the sustained and intelligent efforts which can alone ensure the successful working of that system?

On this issue the rapid spread among the work- ing class of education, and of the feeling of mutual confidence which all genuine education fosters, may well relieve us of serious hesitation. No one who has marked the eager interest which men of that class now take in social questions; or who, like myself, has seen hundreds of colliers in regular attendance at a course of systematic lectures on Political Economy, delivered week by week for three months on end, by a popular, but none the less thoroughgoing, exponent of that subject,* can entertain a doubt that participation in profits, if once clearly set before the working classes of this country, will soon be thoroughly understood and appreciated by them. My own very decided conviction is, that participation has a great future before it in this country; and I am strongly con- firmed in that view by the opinion of the leading French exponent of the system. Writing to me on Nov. 8, 1880, M. Charles Robert expressed himself in words which I translate as follows:—

"Wherever there exist in combination industrial

* Mr. W. M. Moorsom, of Trinity College, Cambridge, delivered, in the autumn of 1880, a course of 12 weekly lectures on Political Economy, to audiences consisting chiefly of pitmen, at five centres in the Newcastle coal district. The lectures were organized under the University of Durham extension scheme; and at one exclu- sively mining centre alone, 400 tickets for the entire course were sold in advance. "No public speaker," writes Mr. Pringle, of Barrington Colliery, Northumberland, "ever took away from our remote county so large a share of good wishes and heartfelt gratitude, nor left behind him such a popular name as Mr. Moorsom."—See *The Common Good*, Jan. 15, 1881, p. 239. Pub- lished at 282, Strand, London.]

energy, intelligence, and the spirit of initiative, the final success of generously-conceived innovations is almost always assured. And where is a greater and better success to be looked for than in England, the country of personal independence, and of combined effort, the classic land of free and fruitful activity, whose denizens are accustomed to mass their individual powers, and to serve as models to every student of the theory and practice of association? The admirable results obtained on your side of the Channel by Co-operative Societies of Distribution, the magnificent development of your Friendly Societies, the formidable power of your Trades' Unions, prove to demonstration that England will well know how to make participation in profits prosper within her borders. English advocates of that system will assuredly obtain a favourable hearing, as well from industrial chiefs as from workmen, and I make bold to hope that we in France shall soon be called upon to register their successes, and profit by their examples."

Before sitting down, I desire to make a practical suggestion to which I attach considerable importance. It is manifest that before participation can be extensively tried in this country with good prospects of success, the results attained on the Continent must first have been adequately studied both by English employers and by English workmen. Now, what are the means as yet provided for pursuing this study? In the spring of 1879, a society composed of employers engaged in industry or commerce was established at Paris, having for its sole object to facilitate the practical study of participation in profits. This society has already published in its periodical *Bulletin* the regulations of the most important participating houses, and has assembled in its library a mass of unpublished rules in force in the less conspicuous establishments. It is now bringing out in a French translation, with the author's latest additions, the work of Böhmert, which is a real mine of trustworthy information, particularly as to results obtained in Germany. Clearly, therefore, an inquirer who wishes to make a practical study of the subject may derive the greatest assistance from the French society. He finds abundant matter in its publications, and, should he desire further information on points of detail, has only to place himself in communication, through its officers, with the heads of houses abroad whose systems he may desire to investigate. But these facilities are as yet restricted to students possessing a good knowledge of French, and a not inconsiderable stock of leisure. In order that they may be effectively thrown open to all classes in this country, means must be taken for publishing, in plain readable English, and at a low price, the most essential facts which have been ascertained by continental research. The work might well be undertaken by a special society, which should endeavour to facilitate in England the practical study of participation, whose objects and whose title should, in fact, be identical with those of the French society. Such an association would disseminate trustworthy printed information, promote the reading of papers, the delivery of lectures, the holding of discussions, and generally seek, by every available means, to spread sound knowledge on the subject with which its operations were concerned. It would also serve as a bond of union and mutual support between such English houses as gave an actual trial to *participation*, and between all persons interested in the progress and development of that prin very important feature of its work would c be the maintenance of close and cordial with the French society, and with the hea movement in other parts of the Continent

In order roughly to gauge the amount port likely to be forthcoming for a scheme kind, I should be very pleased to receive, a College, Cambridge, the names and add any persons, whether occupied or not in i or commercial pursuits, who, were such to be called into existence, would be di join it.

DISCUSSION.

Mr. Wolstencroft felt sure that the scheme applied with success to many industries, bu others, piece-work would be superior. He ga instances where double the amount of work with the same number of hands on piece-wo much less expense to the employer. He did the system of participation would be app collieries. There the workings were let out i a man, who was paid so much a ton for all which came out of the drift. He was not pa dirt, but only for the amount of coal rais higher price for that raised in good cond Oldham the co-operative system was comme was found to answer very well, one mill dividend of 25 per cent.; but, in conseque was a rush of capital into this industry, and mills were built at one time, some containin quarter of a million spindles, and then th became glutted. Participation might readily to warehouses where the work could not be the piece-work footing; but generally he n that it was best to pay men by results.

Mr. Lloyd Jones suggested that it would not to discuss the disputed question of piec day-work. Before dealing with the que wished to correct the Chairman's statement trades unionists of the country were a proposals for a participation of labour and p was not aware that such was the case, an perhaps as large an experience of trade unioni man in the country. He knew all the leader branch of industry where trade unionism exi he did not know a single case of personal h such a scheme. He knew that Mr. Briggs succeeded with it, and no doubt that gentl many grievances, which he would make kn he published his statement; but there was qui side to the question, which it would be tim to deal with when Mr. Briggs had publ statement. Nothing could be more interes such a subject as that now brought fo for no other reason than that it was impossible that the present industrial syste country could go on. He joined trades un years ago, and had been in intimate conne members of various trades unions from that d and he was more satisfied than ever that the which business was now conducted would break down unless interests which were an could be reconciled. The partnership spoken answer where you got a man of large intelli benevolence, who undertook to do the work in called his workmen to assist him, and where men were absolutely satisfied as to the intenti man who called on them to co-operate with there was nothing more certain than th suspicion of the employer by the employed ca whole thing would break down. He did not

he reader of the paper where he spoke of the break down of the attempts at co-operative production in this country.

Mr. Taylor said he did not speak on co-operative production. His remarks were exclusively limited to industrial partnership.

Mr. Jones said he had alluded to Mr. Briggs' scheme, which consisted simply of a bonus given by the vote of the shareholders at their half-yearly meetings, the workpeople being entirely at the control of the shareholders. The shareholders voted according to what they thought it was right to give, and the workpeople found themselves gradually cut off until their bonus entirely disappeared. He would say further, that the workpeople felt all along that a portion of the design of that experiment was to draw them away from the trades unions to which they belonged. Now, there were a number of gentlemen present who were engaged in the work of distributive co-operation, and the workmen connected with that had in their hands what they called the organisation of the ...ing of the country. The business they were doing was, perhaps, £14,000,000 or £15,000,000 a year. They had, therefore, in their hands the orders from all people belonging to these various stores, and, having those orders, they could regulate production precisely as it suited their purpose. Instead of manufacturing speculatively, as most manufacturing was carried out, and at very serious loss occasionally, they manufactured in reference to the custom which they had organised. Thus the demand came before the supply, and the fatal point in the present system, where ...overdid the supply of any given article, and ...fore reduced its market value, and ruined profits, as had been the case in the coal industry, was avoided. In this way they produced a scientific relationship between the supply and the demand. The co-operators had established a place, not referred to in the paper, at Leicester, called the Leicester Boot and Shoe Works. Sometimes they did not make heavy profits, because they foolishly competed with the outside market, when it was no absolute necessity to do so. Here there was no speculation, and no fear of loss which they did not ...ly bring upon themselves, and the demand and supply was brought into a kind of harmony, which avoided the bankruptcy and ruin so common in trade. He believed that if employers would put themselves in friendly relationships with their *employés*, they might hit upon some plan of running side by side without injuring each other, and bring out of the industry of the country fair wages for one, and fair profits for the other.

Mr. Millar said it ought not to require many words to satisfy anyone of the advantages of the participation of labour. It was proverbial that carelessness was ...ion. He used the word in no offensive sense, but simply as the absence of care. Anything which would identify the interests of the labourer with his ...r was certain to result in good. If, therefore, it was very good to allow labourers a little participation in profits, it would be better to allow them to have ... and best of all, if such a thing could be arranged, their interest in it should be entire. The chief difficulty that appeared to crop up, was that there were three kinds of labour; constructive labour, destructive labour, and distributive labour, and it was a very difficult thing indeed to say what proportion of the profits of destructive labour should fall to the labourer. The result of labour, until it was ...ained, was an unknown quantity, and in that unknown quantity, it was quite right that the labourer should participate, and have an equal share of it as a remuneration for his contribution to bring it about. Unfortunately, the labourer could not wait for the ...t; he generally lived from hand to mouth, and, ...re, he sold his day's labour at the market rate, the market rate was the estimate which somebody else formed of what the result was likely to be. Wherever the result was likely to be very prosperous, a man would willingly pay double for the labour. If therefore, the reader of the paper, instead of saying the labourer was to share in the profits of industry, said he should share in the results of the industry, it would present the question in a very different aspect. There were very few labourers indeed who were prepared to stake their daily bread on the results of their industry. In fact, in these days, we had too many instances where combined industry was most disastrous. If the wages were not equitable, the man ought to get more; but the capitalist would only pay the market rate, which fluctuated like the market rate of anything else. In England, we had instances of that sort of co-operation on a large scale. One instance was the old East India Company, where, originally, the dividends of the shareholders were limited to 10 per cent., and, consequently, they had no other field for disposing of their surplus profits than in raising the wages of their *employés*. These were raised to such a grand sum that they commanded the very finest industry and talent of Great Britain. The system, as carried on at the India-house, closely resembled that described in France. Part was paid in the shape of wages, and part in the shape of bonus or retiring allowances. It would be a grand thing for every labourer if he were entitled to a retiring pension at a certain age; but very few would like to trust their employers with such an amount for 30 years; and he certainly should prefer to get it in cash, and to put it in some insurance office, in which he had more confidence.

Mr. Ganney agreed with Mr. Lloyd Jones that the industrial system of the country must be changed. As one of the Society of Arts reporters at the Paris Exhibition, he had some opportunities of observing from different standpoints the position of labour on the Continent as compared with England; and he had spent some years in America. He had noticed there that employers would cheerfully pay dollars a day and succeed, where an English employer would scarcely pay shillings and fail. The fault lay very much in this, that there were not sufficient competent employers; the men who directed the large industries of the country in many cases not being practically acquainted with the business they carried on. In old days, the men who built up the trade of England were actual workers, but now he knew a series of trades which were being positively annihilated by foreign competition, for instance, the English clock and watch trade, in which men now made money by putting the London trade-mark on foreign articles. That was a state of matters for which he long worked to find a remedy, and he trusted that the direction in which the reader of the paper was working, viz., the practical co-operation of the workmen with competent employers, would lead to a solution of the difficulty. He had made attempts to introduce the co-operative system, both in London and in Coventry, but in neither case had they been successful, on account of the inability of the workmen to find sufficient capital when trade was in full swing. If they could only get large capitalists to induce practical workmen to take an interest in their business, many trades which were now languishing on account of the antagonism between the capitalist and labouring classes, would revive, and increase to an extent which few could conceive.

Mr. Chapman regretted that the reader of the paper had not called attention to the speech of the Emperor of Germany, which appeared in that day's papers, in which he alluded to the scheme brought forward by Prince Bismarck for improving the condition of the proletariat. That scheme, as published in the *Spectator* for January 5th, consisted in making assurance against accidents compulsory in some branches of labour, half the premium to be paid by the employer, and where the

wages were below a certain amount, two-thirds of the remainder to come out of the poor-rate. The fund thus raised would provide sick allowance up to two-thirds of the wages, with a provision for the widow and children. It was also intended, he understood, to carry the scheme still further. The failure of Messrs. Briggs' experiment had been referred to, but what was the cause of the failure? The profit, the second year of the experiment, was £30,000, but when the price of coal was considerably raised, and the profits grew to £60,000, they did not like dividing it amongst their workpeople, and that was the cause of the failure. There were many examples of the success of this system in England, and he was sorry he had not the materials with him to quote them.

Mr. H. Solly desired to express his most earnest sympathy with the movement, which was evidently growing, for promoting this participation in profits, and did not think they need be at all discouraged by the failure of one or two attempts in this direction some years ago. One had just been referred to by Mr. Chapman, and they knew how many failures the co-operative movement suffered before it attained its present success. It had almost entirely died out before the Rochdale Pioneers began their wonderfully successful enterprise. There was hardly any social, industrial, or political movement which had not to encounter failure at the outset; and it was only in that way that experience was gained which led to ultimate success. Mr. Chapman, however, was in error as to the cause of the failure of Messrs. Briggs' experiment. He knew Mr. Currer Briggs very well; and he was one of the last employers who would grudge his workmen a share in the profits of the business. If he had been ever so grudging, he would be the last man to be so when he saw beneficial results accruing to the firm from the participation. The real cause of the failure was the relation, or supposed relation, of the firm and the *employées* to the trades union. He would not go into that, but he did not consider the men were to blame at all in the matter. Mr. Briggs himself deeply regretted the cause, and probably if it had rested with him the difficulty would have been got over. The same with Fox, Head, and Co., of Middlesborough. Jeremiah Head threw his whole heart and soul into the matter, and as far as the profits went, it worked well. As regards the beneficial results of this system, he had recently been informed that the manager of the stationery department in one of the largest firms in the metropolis had saved his employers nearly £800 a year through the introduction of the system. This was simply because he felt it to his interest to make every effort to prevent waste. When he mentioned this fact on a former occasion, an employer said that the man must have been shamefully neglecting his duty not to have made this saving previously; but even granted that it were so, you must deal with facts as you find them. If you found a certain system would induce men to be more careful, and increase the profits of their employers, and another would not, it was only common sense to use the one system and not the other. This had been proved to be the case, for where this system was carried out, the saving was immense. One objection often brought against it was, that while the workmen were willing enough to share the profits in a good year, they would not like to share the lesser in a bad year. His answer was this, which might not be correct, but he had always felt it to be sufficient, that the bonus should be calculated, making allowance for the losses of bad years. He did not imagine there would be any difficulty in making a calculation of that character. He entirely endorsed the remarks which had been made, that some change in our industrial system was inevitable. The trade of this country was undoubtedly in a very serious condition; every now and then the reports from consuls abroad stated that in this and that particular trade we were being superseded, sometimes by continental firms, but chiefly by Americ was informed by a relative of his, who was i in New York, that a mining engineer in En him that his men always preferred American t in illustration of that they found intelligent r had worked in America, telling them that the more co-operation between employers and there than in this country. He need not g causes of that, but the effect was undoubted. was carried out in consequence in a way in whic could be where the employer and workmen w friendly terms. Then, again, the question of t laws came in, but that was beside the prese He was thoroughly convinced that, although system acted chiefly upon the pocket, it was large extent, a moral question as well; an appeared to him that the lesson to be dr Leclaire's life and character was of incalc portance. He was thankful to know that hi was being held up, not only by Mr. Tayl Chairman, but by a lady friend of his now pre Hart, who had brought it before workmen's they could succeed in introducing a more spirit into the relation of employers and worl get masters and men to have that true sym one another which must lie at the foundat success, this bonus system would come in and It never would be broken down, if there we same brotherly spirit as prevailed in Leclaire's ment.

Mr. Nuttall understood Mr. Taylor to su under this system, new profits might be cre were now lost; he did not ask that the work be given anything which the employer now h but that the workmen should be induced new profits, and have a share of it. If what he meant, he did not see how any could object, but he would be glad to workmen to produce more and waste less, a more friendly terms with him than hitherto. probably live to see this system take root in but it had not done so yet, for which, many doubt could be given. The principal reason was, because the tendency of the age was capital per head was likely to be employed in than in previous years. In the cotton trade the employer £200 per man, and in the engin iron trade about the same. Now, it took man a good many years to save that capital. shoemaker worked for himself in the old could carry his kit with him round the count easy for him to work on his own account, an profits for himself, or to join with others, bu so now. There were large workshops in tha in every other, and the amount of capita per man was much greater than form this must be the tendency in all trade machinery would have to do the wo manual labour had hitherto done; th would be more difficult in the future for th themselves to become the owners of the work they were employed; and he felt very stron that whatever they might desire, the end wo the public themselves would ultimately capital, employ the workpeople, and share t He did not agree with many of their fri thought the workmen would ultimately b owners of their own works; nor did he ev desirable that that should be so, because th of the workman was the same as the tend employer; he would make all he possibly c the customer. He would sell his shoes or dear as he could, and think he was doing ri capitalist did now; and not only that, bu pay the least possible wages. The workm where he was not actually employing but had to employ others, would pay the low

had seen this actually done times out of e had seen the workmen in Oldham—where kmen were shareholders in joint-stock s—in one mill where they were employed, t was not only right, but that it would pay workmen an interest in their work; and he e same workmen as shareholders holding £5 ivested in the concern, urge that it was not that it would not pay, to give other workmen he profits. These were practical difficulties. in years to come they would see a considerrement, but not in the direction that some of ls and well-wishers really desired. He had ed with cotton buyers, and fail, because altry bonus of £1 a week extra to him, was in the receipt of £7, £8, or £10 a s, had no influence—it was too small. £5 a week extra, and he would neglect his n at Liverpool, and, perhaps, save oneme-sixteenth of a penny per lb. in buying; ler of yarn in Manchester would take the . But he had seen other workmen begrudge xtra £5 or £10 to men who had acted in this they might have saved hundreds of pounds e middle-class and high-class employers, lid not do that; and they, as working learn to be more liberal in such matything would succeed anywhere, it ought in Oldham, for there every cotton-mill t had risen from a workman. He knew en he was a workman, he could produce hether he did or did not waste his master's terial; and every workman knew that he terial; every trades unionist knew it, and yer knew it. The point was how to get it and invest it. In Oldham, there were nen, who owned £4,000,000 of capital, all the cotton, iron, coal, or paper trades; they ought to give their own workinterest in their works, which would larger profit divisible among them as ; yet they did not do so, and it be said that they were friendly to e. The plan had been tried in many four or five cotton mills—with the otton, the seller of yarn, the engineer, and others, and they had tried it in des. In an Oldham engineering works, as director for many years, and knew it, every workman was actually made eholder to induce him to take an ins work and save material, but what was result? Those who were dissatisfied with combined with others in the workshop or et more. If they could not get it from the oreman above them, they then tried to If they could not succeed in that, they it from the manager, and when they could om him, they tried to remove the manager. ould not remove him, they tried to remove directors, and the result was they had to hised. Everybody must regret to see st the workmen themselves, but it was ding these facts. What was wanted, t the bulk of the workmen to see ld be to their interest to save instead of d that there was more pleasure in working an in idling time away during working could not see how any working man could asure in idling time away, either his own or 's, but they had got into that habit, and he y see his way yet to any practical scheme to lk of the workmen to become more economical ers' time, tools and materials. He had tried e in a colliery. He and a few friends olliery and tried to make it succeed. They akmen an interest in proportion to what they did, and it succeeded with them, but when they went down into the pit and tried to induce the cutters themselves to use less powder, to be more careful about mixing dirt with the coal, and to keep the water away from the mine, and so on, it was impossible to induce the colliers to take any interest whatever in the master's affairs. He offered them an extra sum per ton, but still they could not do it. He thought there was always a fear in the mind of the workmen that there was something else in view when anything was offered them, and the way in which they had been treated necessarily caused them to have those feelings. It would take many years before workmen would feel, as Mr. Jones put it, that they were really trusting somebody deserving of being trusted. He could not tell the meeting one half of what he should like them to understand on this subject, but he thought there were many forms of industrial partnership and co-operation which would succeed side by side with each other. It had succeeded in the works of Messrs. Platt Brothers, of Oldham, the largest engineering works in the world. There there were 20 or 30 men, to whom they paid £1,000 to £1,500 per annum each, with a bonus in addition, but they did not allow the bonus to be withdrawn. It was accumulated with the profits on it, year after year, and when they had been in the firm a certain number of years, they were entitled to sell out. He had many companions. half-a-dozen of whom were in receipt of £500, £600, or £800 per annum, with a bonus, who had been their principal foremen for years, and who did study their employers' interest and their own. But the bulk of the workmen had no interest in the concern; only the heads of departments. It succeeded at Accrington, in the machine works there, and in many other places where heads of departments only were taken into account. He should have been glad if Mr. Taylor had told them where it succeeded what proportion of capital per head was employed, and he should imagine that in the house painters, watchmakers, and many of those industries, the capital was very small indeed, and that there it would succeed better than in large concerns.

Mr. Benjamin Jones said the last speaker had gone into a great number of details to show why the participation of labour in profits should succeed, and then why it should not. Some years ago he was as thorough an advocate of labour having a share of profits as could be found anywhere; probably, he was only an instance of a sort of ebb and flow of opinion which had taken place amongst working men generally. Some years ago, the feeling amongst hundreds and thousands of workmen was that this participation was a good thing; but a great proportion of them, who had been working hardest and thinking most, got rather rich, and then changed their minds, because they got into the position of capitalists. There were concerns where they gave labour a share; but when they found they were getting rich, they thought they could do without the labourers' co-operation, and stopped his profits. Then bad times came, and profits dwindled away, and many believed it was on account of what he considered the unjust treatment of the labourer; and some of those who, in the high tide of prosperity, were against a division of profits, were again changing their minds, and coming to believe that it was the right thing after all. No one had mentioned Mr. Taylor's suggestion to have an association to discuss this question, but the discussion which had already taken place showed how useful it would be; and he thought they could not do better than form such an association, where details could be gone into. It seemed to him an incontestible fact, that to give a man an interest in the profits must have an influence on his industry. Take his own case; he was in service, in a position, where he thoroughly enjoyed the work he had to do, and he would not exchange it on any account.

It might be said that, with such a position, no inducement offered him would make him more zealous, but still he must say that when he had made what he considered a good hit for his employers, it rankled very much in his mind that it did not add a 6d. to his wages. He considered it was essentially unfair that capital should take all profits which resulted from enterprise and integrity of industrious labourers. As the working classes of this country increased in intelligence, they would make up their minds that they would have a greater share in the produce of their industry, and the question for capitalists would be, would they have a grand battle between their *employés* and themselves, or try to devise some such means as Mr. Taylor had suggested, for uniting their interests, and sharing their profits with them. If the question was left to the workmen, they would devise means by which the capitalists should only be allowed 3 or 4 per cent. on his capital. Personally, he should prefer such a solution, but it would take a long while, and he doubted whether it would be applicable to all industries; and, in the meantime, he welcomed the suggestion now made as likely to bring the two great classes into more amity with one another.

Mr. Trewby said the question had been asked, why this principle succeeded in France, and not in England; but he thought the instincts of the two nations were very different. A Frenchman was content to live in part of a house, while an Englishman wanted a house to himself. Then there was a vast difference in emoluments for the same kind of work, as in the case of the clergy, where one man received £1,000 a-year for less work than another received £100 a-year for, and yet they were not willing to set that right. The same kind of thing applied in all industrial occupations. There was a kind of aristocracy in manufacture and distribution. Mind naturally took precedence of the actual labour, and it became the function of the mind to draw around it other minds. No nation had done so much towards increasing the distribution of products as England, and it had been done by simply making the labourer a partner to the employer. In the large distributing firms, down to a certain grade, each man received an emolument according to the profits of the concern. In the large wholesale firms, the buyers were paid according to the amount of the turnover, and under them were salesmen, who were also paid according to their ability. In the case of the large painting and decorating establishment in Paris which had been referred to, he did not suppose there was a large amount of capital employed; but how would the principle work if it were applied to all concerns of the same kind? There was no outlet for a man's ability; if he wanted to start for himself, he had to face the fact that he would lose whatever he had deposited in the concern. In this country a man could work his way up to the top of the tree, and then strike out for himself. The lowest class of labour was always regulated by the demand for increased pay.

Mr. Mineard said he had looked at this question from three different standpoints—as a workman, as a foreman, and as an employer, and he had felt, from the time when he knew how to use his tools, that he ought to have an interest in the work he had in hand. The only interest he could then show was to do his work in the best manner he could, and the result was that he almost always remained with his employers as long as it suited him to stay. When he was a foreman, he made a similar suggestion to that brought forward by Mr. Taylor. He was once carrying out a large job in the country as building foreman, and he suggested to his employer that he should have 10 per cent. on the profits of it, he, on the other hand, offering to deposit 10 per cent. as his share in case of a possible loss. That offer, however, was refused. He was now an employer, being what was called a speculative builder; and, although in good times a builder could make fair pro[fits, in bad] times, in the same neighbourhood, and b[uilding the] same class of property, he might lose twice a[s much as] he had an opportunity of earning in good yea[rs. During] the last two years he had been, at one tim[e, losing,] and there were then men in his em[ploy who] offered to let him have every pound [....] He believed this vexed question of capital [and labour] could only be solved in the mode suggest[ed by Mr.] Taylor; but it seemed only fair that those [who shared] the profit should also share the loss. He [was] willing to join such an association as had [been men]tioned, for the purpose of enlightening th[e workmen] themselves, for it could only be done by first [educating] them. He had men in his employ whose w[ages he had] often raised, and he never let a holiday go [by without] giving those in a leading position a bonus. [He had] seen waste go on in large metropolitan firms [to such an] extent that he had actually thrown up his [....] the other hand, you might drive men by p[iecework to] do a lot of work which was worth nothing. [He had] found piecework answer in the simplest oper[ations, such] as excavation, and then he never attempted [to reduce] a man's wages because he earned a good dea[l.]

Mr. George Shipton moved the adjourn[ment of the] discussion, which was seconded by **Mr. Bot[h...]**

[The adjourned meeting will be held [on Friday,] February 25th.]

CORRESPONDENCE.

"SUGGESTIONS FOR PREVENTING SMOKE."

As it would appear that the statements [contained in] my letter of the 29th ultimo, have not b[een clearly] understood by Mr. W. D. Scott-Moncrieff, I [will endea]vour, in as few words as possible, to make [them] clear to him.

In Mr. Moncrieff's scheme, it is proposed [to pass all] coal intended for fuel through gas retort[s, and, in]stead of taking 10,000 cubic feet of gas pe[r ton of] the coal, to take 3,333 cubic feet, and to [pass three] times the quantity through the retorts, or [in such] proportion that may be found most convenien[t. "The] result of doing so (he says) is startling;" a[nd further] he states that the coke or smokeless fuel resu[lting there]from would give out 20 per cent. more hea[t than com]mon coal, and would therefore be found of g[reat value] for heating the retorts, while the surplus [coke] not required in the manufacture of gas, co[uld be used] for domestic purposes, thus rendering Lond[on a smoke]less city.

Now, if the before-mentioned is the sch[eme which] Mr. Moncrieff advocates, then I most e[mphatically] repeat that it has never even been tried—[much less] adopted—at the Woolwich Arsenal Gas Wo[rks.]

In Mr. Moncrieff's letter which appe[ared in the] *Journal* of the 11th inst., he remarks that i[n my letter] of the 29th ultimo, I confirm the statem[ents of his] paper in every detail and particular. Now [taking his] several remarks in the order in which they [appear in his] letter, we shall see how far his statements a[re borne out] by facts.

Mr. Moncrieff alleges that when in di[rection as] manager of the gas works at Woolwich [....] used a "short extraction." This is entirel[y wrong, as] in every case he allows the coal—whether [common] coal or cannel—to remain in the retorts ju[st as long as] is necessary for extracting all the gas from [it (and not] one-third only, as recommended in Mr. [Moncrieff's] scheme), and the length of time necessary fo[r the opera]tion depends entirely upon the character o[f ...]

on gas coal, about six hours, and for cannel, r hours.

mcrieff then alleges that the fuel resulting short extraction is superior, and that I con- by stating, "that the coal used was volatile id that on a *long extraction* it contained very ing properties, and was not used under the Now, my letter of the 29th ultimo contains atement, but the very opposite, for I most pointed out that it was the coke from the orked during a four-hour (or short time) id with a volataile cannel coal, which con- y little heating properties, and consequently sed as fuel under the retorts. The words in Mr. Moncrieff's, not mine, and they do not where in my previous letter.

ncrieff then asks, do I mean to say that the orse under a short extraction than under a Not having tried his scheme of "short ." I am unable to answer this question. ate is, that the coke resulting from the six- es, for which we always employ common gas ly "Pelaw," is of good quality, and possesses g properties, and makes a very good fuel; hat resulting from the four-hour charges, for invariably use a cannel coal, is simply as a fuel.

ncrieff then asks, do I mean to deny that the mes off during the first two or three hours, leny that it comes off most rapidly during l? I am not aware that I have made or de- statement in regard to either of the above and, as I am only concerned at present with nts made by Mr. Moncrieff in regard to the nal Gas Works, I do not think it necessary he subject under discussion. At the same ply to his last question, I do most distinctly naving adopted the scheme which he advo- is paper, even to meet a few exceptional s. My endeavour has always been to get, as much gas as possible out of the coal, and le or none in the coke, whereas, in Mr. Mon- eme, he advocates taking only a little out of bout 3,000 cubic feet per ton) and leaving a portion—between six and seven thousand -in the coke.

hough I shall be pleased to adopt any plan en practically tried and proved, and which me to manufacture a better and cheaper gas, the present, and until Mr. Moncrieff has better and more reliable to put before us, to fficient intelligence" to deter me from to convert good profitable gas works into nts for partly carbonising coal and manu- a gaseous coke or smokeless fuel, of such lue, that in the condition in which it would the retorts, the mere handling and exposure her for a short time would, I believe, convert ap of "breeze" or rubbish.

ncrieff states, in conclusion, that he was un- ny official relations between Mr. Wallace and l, further, that he is not, even now, aware relations are. I can scarcely imagine this to after his reading my letter of the 29th ultimo, stscript, and seeing that there are so many taining the information had he wished for it, hat I have been connected with the public the past 30 years. I can only attribute Mr. s stated continued ignorance to the fact that n as little trouble to inform himself on this did to investigate and ascertain the true state before making the incorrect and random which appear in his paper.

nal, Woolwich, Feb. 14. J. A. C. HAY.

name has been most freely used by Mr. in the paper he recently read before the Society of Arts, I beg to say that the statements made by him referring to the Royal Arsenal Gas Works are wholly incorrect, and were not given to him by me. Neither do I know anything of Mr. Moncrieff, further than that the first time I ever saw him was less than a month ago, when I met him looking over the works here as an ordinary visitor. JOHN WALLACE.

Royal Arsenal Gas Works, Woolwich.

[In order to prevent further correspondence, the letters from Mr. Hay and Mr. Wallace were sent, in proof, to Mr. Scott-Moncrieff, with a request that he would reply to them, if he wished to do so. His answer is given below. A few sentences have been omitted, which refer, principally, to personal matters, rather than to matters of fact. This correspondence will now be closed.—ED. *S. of A. J.*]

I have the proofs you have sent me of letters from Mr. Hay and Mr. Wallace. The former gentleman, I find, is not known among gas-managers as an expert; it is to be presumed, therefore, and he seems to admit, that he obtained the information which forms the basis of his letters from Mr. Wallace. Your readers may judge of the disadvantage I am at in this corres- pondence, when I inform them that so far from Mr. Wallace having "seen me for the first time less than a month ago," and "having met me looking over the works as an ordinary visitor," he was specially introduced to me last autumn by an engineer of the highest eminence, belonging to the Gun Factory, and a personal friend of my own. On that occasion, Mr. Wallace took me to what he called his "thinking-box," and we went into the figures of my proposed scheme, which he did with expressions of the greatest interest. It was then, and on other occasions since, that he told me of his experience with regard to short extractions. It is to this information, and this alone, I referred. To make a general practice of a short extraction at Woolwich Arsenal, where the fuel used for heating is out of all proportion to the quantity used for light, is what no man in his senses would think of. This, however, has no connection with what Mr. Wallace did or did not tell me about the short extractions. In Mr. Hay's last letter, he suggests that nothing but the every day practice of gas-making had been resorted to at the Arsenal. In his previous letter he speaks of exceptional practices. I cannot reconcile these discrepancies, nor do I care to make the attempt.

W. D. SCOTT-MONCRIEFF.

Feb. 17.

MEETINGS OF THE SOCIETY.

ADJOURNED MEETING.

Friday evening, at eight o'clock:—

FEBRUARY 25.—Discussion on Mr. Sedley Taylor's paper on "The Participation of Labour in the Profits of Enterprise." W. H. HALL will preside.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock:—

FEBRUARY 23.—"River Conservancy." By CHARLES NEVE CRESSWELL. The Hon. CHARLES WENTWORTH FITZWILLIAM, M.P., F.R.G.S., will preside.

MARCH 2.—"Lighthouse Characteristics." By Sir WILLIAM THOMSON, LL.D., F.R.S. F. J. BRAMWELL, F.R.S., Chairman of Council, will preside.

MARCH 9.—"Ascents of Chimborazo and Cotopaxi, in 1880." By EDWARD WHYMPER.

MARCH 16.—"Buying and Selling; its Nature and its Tools." By Prof. BONAMY PRICE, M.A. Lord ALFRED S. CHURCHILL will preside.

MARCH 23.—"The Increasing Number of Deaths from Explosions, with an Examination of the Causes." By CORNELIUS WALFORD.

March 30.—"Recent Advances in Electric Lighting." By W. H. Preece.

April 6.—"The Manufacture of Glass for Decorative Purposes." By H. J. Powell (Whitefriars Glass Works).

Foreign and Colonial Section.

Tuesday evenings, at eight o'clock:—

March 1.—"The Languages of South Africa." By Robert N. Cust.

March 15.—"Diamond Fields of South Africa." By R. W. Murray.

April 5.—"Trade Relations between Great Britain and her Dependencies." By William Westgarth.

Applied Chemistry and Physics Section.

Thursday evenings, at eight o'clock:—

February 24.—"Deep Sea Investigation, and the Apparatus used in it." By J. Y. Buchanan, F.R.S.E., F.C.S. Captain Sir George S. Nares, R.N., K.C.B., F.R.S., will preside.

March 24.—"The Future Development of Electrical Appliances." By Prof. John Perry.

The meeting previously announced for April 7 will be held on May 12.

Indian Section.

Friday evenings, at eight o'clock:—

March 4.—"The Results of British Rule in India." By J. M. Maclean.

March 25.—"The Tenure and Cultivation of Land in India." By Sir George Campbell, K.C.S.I., M.P.

May 13.—"Burmah." By General Sir Arthur Phayre, G.C.M.G., K.C.S.I., C.B.

Members are requested to notice that it may be necessary to make alterations in the dates of the above papers.

Cantor Lectures.

Monday evenings, at eight o'clock:—

The Second Course will be on "Watchmaking," by Edward Rigg, M.A. Three Lectures.

Syllabus of the Course.

Lecture III.—February 21.

Necessity of efforts to promote the art in this country—Need of education, theoretical and practical, in horology—Literature—Great want of uniformity in gauges, screws, &c.—Exhibition of ordinary and complicated watches, and of watchmakers' tools—Conclusion.

The Lectures will be illustrated by Specimens, Models, and Diagrams. The different movements, &c., will be shown enlarged on the screen by means of the Aphengiscope and the Electric Light.

The Third Course will be on "The Scientific Principles involved in Electric Lighting," by Prof. W. G. Adams, F.R.S. Four Lectures.

March 7, 14, 21, 28.

The Fourth Course will be on "The Art of Lace-making," by Alan S. Cole. Three Lectures.

April 25; May 2, 9.

The Fifth Course will be on "Colour Blindness and its Influence upon Various Industries," by R. Brudenell Carter, F.R.C.S. Three Lectures.

May 16, 23, 30.

Admission to Meetings.

Members have the right of attending all the Society's meetings and lectures. Every Member can admit *two* friends to the Ordinary an Meetings, and *one* friend to the Canto Books of tickets for the purpose have l to the Members, but admission can also l on the personal introduction of a Meml

MEETINGS FOR THE ENSUING W

Monday, Feb. 21st...**SOCIETY OF ARTS,** Adelphi, W.C., 8 p.m. (Cantor Lectures. Rigg, "Watchmaking." (Lecture III.)
Royal Asiatic, 22, Albemarle-street, W., 4 John Cain, "On the Kois or Ghounds of C 2. Mr. Cyril Graham, "Remarks on Lasghian Language of the Caucasus."
Royal United Service Institution, Whitehal Mr. W. H. White, "Pumping Arrangem War Ships."
Institute of Surveyors, 12, Great George 8 p.m. Mr. G. R. Crickmay, "Ecclesias tions."
Medical, 11, Chandos-street, W., 8½ p.m.
Victoria Institute, 7, Adelphi-terrace, W. Dr. J. P. Thompson, "Implements of t as a Primitive Demarcation between l Animals." 2. Mr. J. E. Howard, "Scie the Caves of South Devon."
London Institution, Finsbury-circus, E.C J. E. Hodgson, "Art Among the Ancien

Tuesday, Feb. 22nd...Royal Institution, Albemar p.m. Prof. E. A. Schäfer, "The Blood."
Medical and Chirurgical, 53, Berners-s street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Max Am Ende, "T the Limiting Dimensions of Girder Brid
Anthropological Institute, 4, St. Martin' 8 p.m.
Royal Colonial, the Grosvenor Gallery Lil Bond-street, W., 8 p.m. The Right I E. Frere, Bart., "The Union of the Va of British South Africa."

Wednesday, Feb. 23rd...**SOCIETY OF ARTS** Adelphi, W.C., 8 p.m. Mr. Charles l "Rivers Conservancy."
Geological, Burlington-house, W., 8 p.m. Holmes, "The Permian, Triassic, and L the Carlisle Basin." 2. Prof. W. J. Soll *Granti*, a new Lyssakine Hexactinellid fr Formation of Canada."
Royal Society of Literature, 4, St. Martin 8 p.m. Mr. W. A. Barrett, "The English Church Music."

Thursday, Feb. 24th...**SOCIETY OF ARTS** Adelphi, W.C., 8 p.m. (Chemical Secti Buchanan, "Deep Sea Investigation, and used in it."
Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m
London Institution, Finsbury-circus, E.C. W. De W. Abney, "One Aspect of Colo
Society for the Encouragement of Fine A street, W., 8 p.m. Mr. J. W. Bradley, tion."
Royal Institution, Albemarle-street, 3 p.m "History of Drawing-room Music." (Le Musical Illustrations.
Inventors' Institute, 4, St. Martin's-place,
Royal Society Club, Willis's-rooms, St. 6 p.m.

Friday, Feb. 25th...**SOCIETY OF ARTS,** John- W.C., 8 p.m. Adjourned Discussion Taylor's paper, "The Participation of Profits of Enterprise."
Royal United Service Institution, Whiteh Captain S. Long, "A Study of the T Blockade, as affected by Modern Weap
Royal Institution, Albemarle-street, W., S. Burdon-Sanderson, "Excitability Animals."
Quekett Microscopical Club, University 8 p.m.

Saturday, Feb. 26th...Ladies' Sanitary Associatic of the Society of Arts), 5½ p.m. Dr. son, "Domestic Sanitation or Health a ture III.)
Physical, Science Schools, South Kensingt 1. Mr. C. V. Boys, "An Integrating Mr. Shelford Bidwell, "The Telegrap of Pictures of Natural Objects."
Royal Botanic, Inner-circle, Regent's-park
Royal Institution, Albemarle-street, W., Stuart Poole, "Ancient Egypt in its Co tions." (Lecture II.)

AL OF THE SOCIETY OF ARTS.

No. 1,475. VOL. XXIX.

ʔIDAY, FEBRUARY 25, 1881.

ications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

ʔHYMPER'S PAPER ON CHIMBORAZO.

ı ordinary meeting, on Wednesday, 9th Ɩr. Edward Whymper will give an account ›ent ascents of Chimborazo and Cotopaxi. xpected that many members will wish to Whymper, it is proposed to make special ıents for this meeting, the usual rules ıssion being suspended for the evening. n will be by special tickets only, and ll be issued to members in the order of on. Should a sufficient number of appli- e received by Monday, the 28th February, y such a course, arrangements will be r holding the meeting in a larger room Society's own room, otherwise it will be re as usual. The names of members ; will be registered, and tickets will be y the 4th or 5th March. Either one or ets will be sent to each applicant, as the ›dation may permit.

ers are particularly requested to take at if they wish to attend they must provide es with a ticket, as no person, member or n be admitted without a ticket.

H. TRUEMAN WOOD, *Secretary*.

CANTOR LECTURES.

iird and concluding lecture of the second vas delivered on Monday, 21st inst., by Rigg, M.A., on "Watchmaking." The r urged the necessity of efforts to promote n this country; and pointed out the need tion, theoretical and practical, in horology. ion of repeating and other watches, was a the screen by means of the aphengiscope electric light.

ƖLASGOW proposed a vote of thanks to the and expressed, in the name of the watch-making trade, the great pleasure that those who attended the course had received in listening to the lectures. It was now easy to obtain popularity by running down the English trade, and he was glad that Mr. Rigg had not sought such popularity, but had been able to speak a good word for the English manufacturer, who produced the best watch in the world.

The CHAIRMAN (Mr. B. Francis Cobb, Treasurer of the Society), in putting the vote of thanks to the meeting, drew attention to the trade statistics, as furnished by the lecturer, and spoke of them as neither creditable to the trade nor to the country. He alluded to the evil effects of trying to keep any trade as a close trade in the present time, and showed how the great business of supplying clocks and watches to the Colonies had gone past this country. He spoke hopefully, however, of the result of the technical horological education, now working under the auspices of the City Guilds, and he exhorted his hearers not to underrate their opponents, but to take and adopt new ideas from whatever source they could obtain them.

The lectures will be published in the *Journal* during the summer vacation.

HOUSE SANITATION.

The Council offer the following Medals for the best Sanitary Arrangements in Houses built in the Metropolis, the plans of such arrangements to be exhibited in the Society's Rooms, Adelphi, in June, 1881, and to be sent in on or before 12th May, 1881:—

1. One Silver Medal for the best sanitary arrangements, carried out and in satisfactory working, in a house let out in tenements to artisans, for which a weekly rental is paid.

2. One Silver Medal for the best sanitary arrangements, in actual working, in a house of the yearly rental of £40, or less, to about £200 in value.

3. One Silver Medal for the best sanitary arrangements, in actual satisfactory working, in a house of the yearly rental value of £200 and upwards, to any amount.

4. The houses must be open to the inspection of the Judges, who, in considering their award, will be guided by the suggestions of plans for main sewerage, drainage, and water supply, made under the Public Health Act, 1875. The houses must have been in actual occupation within the last three months, and a Certificate must be given by the occupiers, on a printed form, stating the satisfactory working of all the sanitary arrangements, such form to be obtained at the Society of Arts.

5. The houses may be old, fitted with modern sanitary arrangements, or may be new. They must be within the metropolitan area of the Board of Works.

6. The sanitary arrangements must include the conditions for good water supply, drainage, warming, and ventilation of the house, and precautions taken against frost.

7. The medals may be awarded to the occupiers of the houses, or the lessees, or the owners.

8. The plans must consist of a ground plan and sections, to the scale of not less than one inch to five feet; details of not less than one inch to the foot. The plans may be accompanied by specifications.

9. The names of the architects, surveyors, or sanitary engineers who directed the sanitary arrangements should be given, and Certificates will be awarded to those whose plans obtain the Medals.

PROCEEDINGS OF THE SOCIETY.

TWELFTH ORDINARY MEETING.

Wednesday, February 23rd, 1881; the Hon. CHAS. WENTWORTH FITZWILLIAM, M.P., F.R.G.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Brevetor, Thomas, Kimberley-house, 2, Evering-road, Stoke Newington, N.
Harris, Edward, London, Upper Canada.
Smith Henry, J.P., Ellingham-hall, Bungay.
Underdown, Robert George, A.I.C.E., Manchester, Sheffield, and Lincolnshire Railway Company, Manchester.
Uren, John C., Cornwall-terrace, Penzance.

The following candidates were balloted for, and duly elected members of the Society:—

Bolas, Thomas, 2, The Terrace, Turnham-green.
Chambers, William E., Eversfield, Sutton, Surrey.
Courteen, Henry, 336, Clapham-road, S.W.
Felkin, Robert William, F.R.G.S., Pennfields, Wolverhampton.
Kirkham, Thomas Nesham, 21, Abingdon-street, Westminster, S.W.
Lee, Edwin, 43, Devonshire-street, Keighley.
Le Rossignol, Francis, 1, Gresham-buildings, Basinghall-street, E.C.
Magniac, Arthur, 36, Hertford-street, Mayfair, W.
Martindale, William, 10, New Cavendish-street, W.
Murray, R. W., 179, Upper Thames-street, E.C.
O'Donnell, William Arthur Maxwell, 4, Gladstone-street, London-road, S.E.
Parr, Samuel, 7, Finsbury-square, E.C.
Pheasant, William Craster, 8, Edwardes-square, Kensington, W.
Raffety, John Henry, 4, The Terrace, Richmond-hill, Surrey.
Swanzy, Francis, 147, Cannon-street, E.C.

The paper read was—

RIVER CONSERVANCY.

By Charles Neve Cresswell.

Continuous floods, abnormal diseases, an spread devastation, crowned by a succe bad harvests, have brought about a sanitary history, and a cry has gone forth, l of David of old, to be "delivered out of t and out of the deep waters." That cry has the precints of Westminster, and the w legislative progress begins to revolve onc In 1879, the Duke of Richmond and Gor already brought in a Bill for the conserv rivers, which passed through the House of but was lost in a flood of political exc In the previous year, at the instance of the of Wales, this Society, as is its wont, led t by a public conference; and, subseq offered prizes for the best suggestions, w object of dividing England into watersh tricts, and organising provision for a supply water as the first necessity for the health ar fort of the people. The Society's *Journal* w with contributions on the part of eminent rities, geologists, and engineers, in respons invitation, whilst the Duke of Richmon above mentioned was the practical and im result. In 1880, nature herself came to th the philosophers, and carried the questio the range of theory and polemics, by a almost unprecedented floods, which follow upon the other throughout the kingdo matter assumed the proportions of a calamity, and the Duke of Bedford led tation to the Minister, composed of a and conditions of men, who had merged distinctions in the sympathy begotten by misfortune. This brief historical retro interesting as a political lesson, teaching the conclusions of science, the experienc neighbours, and the silent testimony occupier's individual sufferings, will not move the public, or rouse the Legislat action. Certain disquieted spirits discer "writing on the wall," but their warnin received with indifference, and the public as it always waits, for a portent; for some tion in the guise of plague and pestilen they have had it in submerged pastures, cattle, deserted homesteads, vacant farm lords in search of tenants in lieu of com for farms, broken dykes, and broken he dismal forebodings everywhere.

I propose to consider the subject of ri servancy under three distinct heads. Fi conservation of rivers for the purposes of tion; secondly, for the purposes of utilisa fertilisation; and thirdly, conservation sense of purification, including, of cou preservation and breeding of fish.

The subject is far too wide for the lim single paper, and I have condensed my draft by cutting it in half. I have only that I have reserved for my audience this the better half of my reflections.

Two measures are now before Parliament for their object the establishment of Con Boards to effect each of these three ob methods differing in respect of details, alike armed with powers to rate the distr

:ed by their operations. The Government re in the House of Lords is certainly more ·ehensive than that to be introduced the House of Commons, but there are icuous defects common to both. The s Thames and Lea, with others, are excluded both measures; both err upon the old lines eating new authorities, with arbitrary districts s defined by the Local Government Board, in- ing the inevitable local inquiry, with its train imlocution, law costs, and correspondence. In entrusting the central department with the charge of duties so novel and extensive, and before the limits of any area of jurisdiction can be defined, the Ordnance Survey Department of the United Kingdom must complete its work. The attention of the public has been lately called to the startling fact that in many districts that survey is still incomplete. This is a task worthy of the Imperial Government, for which the Department is in every respect qualified; moreover, the cost should be borne by the State, and not be cast upon the rate-payers in the several localities. It is alleged that Upper Thames Valley Commissioners expended y £5,000 out of their own resources in this minary survey, that should long ago have been leted as part of a national work.

; functions of Imperial administration end those of local self-government begin, and Department intervene at all in the definition eas, it would find abundant occupation in eting that survey, which is described, on high rity, as in a more backward condition than f any nation in Europe.

h regard to the local jurisdictions to be d by these Bills, Mr. Magniac's measure errs he side of excess, while the Government ure errs rather in the opposite direction. he one case we have a redundance of rities which may clash, and, in the other, inations of several basins, too wide for at control. The Government Bill might de the basins of the Trent, of the Ouse, and he Aire and Calder, within the definition of basin of the Humber. The basins of the s would be within that of the Severn; and if are included under one general Conservancy d, we shall combine areas which have neither raphical affinity, community of interest, nor ity of cohesion. There is no definition in Bill of the basin of a river, and it is mani- that such rivers as the Wye, the Trent, the Calder, require the supervision of a ate conservancy. Mr. Magniac's Bill, the other hand, proposes, as the unit of a triplet of parishes, or a single muni- borough. A combination of these units titutes a district, and a General Board will almost despotic authority over the basins of s which have their outlets in the sea. The at and limits of such districts and sub- icts is left to the sagacity of the Government ector to determine. They ought, in my ble opinion, to be defined by the Act itself, rwise we shall be overlaid by a multitude of y jurisdictions in counties, such as those of oln and Nottingham. The first of these con- 750 separate parishes, besides sundry Town ils, the latter 300 parishes, comprising nine -law Unions. And we are confronted by the possible creation of 250 separate sub-districts in the county of Lincoln, each having its own limits and independence of action; each moved by its own jealousies and prejudices to thwart and hamper those who are situate below, above, or around them. The General Board, it is true, has the power to restrain mis-directed energies, as well as to enforce the performance of duties required by the Act. How this Board of Control will avail to overcome local obstruction—the inertia and stolidity of the provincial mind—is yet an unknown quality. It is, in any event, a leap in the dark, and a novel experiment in local self-government.

The simplicity of the Government Bill is in accord with the tendency of modern legislation, which aims at concentration rather than the diffusion of local authority. There is, indeed, a maze of juris-dictions to be found on the face of every county, overlapping and jostling each other in most admired disorder. If the Legislature could find time and occasion to determine once for all the unit of local administration, it would cut the Gordian knot of sanitary legislation. Every constituted authority would thus consist of groups or combinations of the units; and we should no longer be bewildered by a redundance of authority—postal, sanitary, magisterial, and parochial, "the rotten relics of antiquity," as a profane critic once styled them, without sympathy, or the hope of intelligent co-operation. It was anticipated that a Liberal Par-liament would effect this grandest of all reforms, by the creation of County Boards—local parlia-ments—within the limits of each county, charged with all the administrative functions of local government, elective and representative, and en-listing the services of that wealth and intelligence which now too often keep aloof from the turmoil of parochial politics. Such a creation as this would re-animate the whole system of local administra-tion. Above all, would these bodies be competent to undertake the conservation of our rivers, having their jurisdiction defined by historic land-marks, well-known and understood by the people. The constitution of these local parliaments has been again and again urged in this hall, and I venture to think that the experiment about to be made in Ireland might be advantageously extended to the counties of England, in lieu of a network of complex jurisdictions, to be developed under the cold shade of an Imperial department, and involving the worst evils of centralisation, which must, sooner or later, break the back of local independence, by saddling upon it that modern "Old Man of the Mountain," the Local Government Inspector.

The Government Bill divides the land to be rated for conservancy purposes into lowlands, midlands, and uplands, contributing in the proportion of one-sixth as a maximum measure of the relative benefits. In Mr. Magniac's Bill there are but two classes, even more widely contrasted. This will tax the energies of the Government Inspector, and throw each district into social fermentation by contests, local and Parliamentary. We are floundering again in the quagmire of local inquiries.

Assuredly it is not the province of the central bureau in Whitehall to indicate the limits of a river flood, or to determine how far this or that land is vitally interested in the maintenance of the arterial drain of every watershed. Desolate

homesteads, and depreciated properties, mark too well the limits and extent of these liabilities. Let the Government pass a Conservancy Clauses Consolidation Act, embodying the general principles and regulations by which all Conservancy Boards will be goverened in the future, such as was enacted for the construction of railways, and of waterworks, and for the manifold purposes of public health, and leave the details of local administration to those who are best able, by local knowledge and experience, to determine them. If County Boards were established, they would be the best tribunals to determine these questions of relative rateability between upland and lowland throughout the watershed; and where a river constitutes the frontier line, or division between two or more counties, the conservancy would be composed of committees of the Board of each county, and thereby we should realise the conception of Mr. Stansfeld, when he recommended "simplification of areas and authorities," constituted for all purposes and functions for which those areas are fit.

NAVIGATION.

For improving and maintaining the navigation; for maintaining dykes already existing, or constructing new ones; for removing obstructions, lowering dams and weirs; in a word, for all the purposes of repair, of maintenance, and of improvement, these Acts confer ample powers, which are indispensable to every conservancy. It may, however, be asked whether rivers beyond certain limits of tidal waters are now required for navigation at all, seeing the marvellous extension of our railway system in every valley and nook of this kingdom. It is certain that many rivers, once the silent highways of inland commerce, are now well nigh deserted, and if the interests of navigation are of paramount importance in these days, it will be necessary, not only to lead the waters into our rivers, but to keep them there for times of need, when drought shall follow present abundance. It is easy, by a judicious expenditure of money and brain power, so to control the stream, that your river shall be full in ordinary seasons; but to replenish and maintain that stream when the cycle of dry seasons recurs, as it assuredly will, is a much more complex problem. The floods of the past few years should not blind us to the probable recurrence of a season when we shall have too little water rather than too much, whether that deficiency be due to the wholesale abstraction of water for the supply of dense populations, or to the reckless misuse of bountiful rain, as the cheaper vehicle which modern civilisation calls in aid to convey the sewage of those populations to distant outfalls. In selecting such outfalls for the disposal of sewage, engineers are apt to think less of the requirements of the riparian owners than of those of the towns which invoke their aid to rid them of a nuisance. In such cases, it often happens that the waters which should replenish the rivers are diverted from its natural channel to another area, where they may be regarded as a curse rather than a blessing. The late Mr. Cubitt, twice Lord Mayor of London, when contemplating the gigantic scheme of sewage interception projected for this metropolis, used to say that the removal of the waterworks to points above Teddington Lock, and *the wilful waste of* water as a vehicle of sewage within the metropolis, would, sooner or later,
pair the volume and scour of the Thames thro
30 miles of its course; and that some of us in
might live to see the results of such improvid
It is rash to prophesy in these days, but when
millenium, which we are all fondly anticip
shall arrive, when "*Sanitas sanitatum,* o
sanitas" will become not a bye-word but a re
we shall keep our sewage out of our rivers a
first condition of their purity, and permit
rainfall to pass through its natural course
polluted, and fitted for the needs of industry
commerce along their course. If our drai
sewers were properly constructed of sufficient
no more than sufficient, capacity, town
would supply its own vehicle, thus avoidi
danger of huge elongated cesspools, which c
the bournes and brooks of our cities into
of pestilence.

IRRIGATION, DRAINAGE, AND PROTECTIO LANDS FROM INJURY BY FLOODS.

For these and analogous purposes, bo
sures provide abundant powers, in add
the power of rating the inhabitants of eac
in order to supply the necessary funds f
requirements of the conservators. There wo
no dispute as to the necessity and efficacy o
provisions. It is only when we come to the
tion of degrees of liability that we can see i
mind's eye a cause of future contention and co
but the question whether uplands should be ra
all remains, and is by no means so easy of so
as has been sometimes contended. Doubtle
low lands benefit most by new works, as they
suffered most by the neglect of old; they h
any event to bear the burden of excessive r
upon the uplands, and this contingency
their price and value; on the other hand,
above the range of floods are benefited b
outfall for natural drainage, and it is know
highlands attract the rain-clouds, and that
rain falls upon the hills than upon an equal
in the valleys beneath. This alone would
argument for not exempting them altogeth
the conservancy-rate, if spread over a suffi
extensive area cannot be a grievous burden to a
of it. Though we accept the principle of a co
liability within certain limits, for the commo
of all, I believe that this vexed questio
never be adjusted in the turmoil of local inq
but must be resolutely grappled with and d
mined in the serener atmosphere of Parli
Already there are rumblings of discontent
the fen-country of Cambridgeshire, where
works, involving an annual charge, have
ago been executed. It would be unjust to
upon those who have had the courage to
themselves an additional burden for the be
others who have been supine or penurious;
demand has been made for a further sub-divi
to be termed "protected lands," which have
pleted local works for their own protection;
are entitled thereby to be placed on an eq
with the most favoured districts.

The prevention of those continuous floods, of
the effects are too patent to every traveller, is,
all, the most important of the duties which
devolve upon these Conservancy Boards. We
been warned, by an eminent authority, that

ments "upon which floods depend are entirely ond the reach of human interference." The aker, of course, referred to excessive floods, we at once admit, without reservation, that ther the salt ocean, nor the sun's heat, ich constantly evaporates it, will be within control of any conservancy. There is "reign of law" in nature beyond the reach Acts of Parliament, and to that law we perforce submit. This self-same salt ocean, the sun's influence upon it, have worked for good, and for the same almighty from primeval times. The question for lation in these latter days is—What are the which have made inundations—once rare, ly to be collected from the memory of the inhabitant—the normal condition of the d counties? On the one hand, it is said that due to the perfected system of land drainage, interest of agriculture, which carries down rainfall from upland and midland with much ter speed and certainty than formerly, whilst capacity of the river bed, which once was to contain the flood, is silted up from to day by mud, and *debris* from the upper lees. On the other hand, it is asserted that drainage increases the absorptive power of surface soils, and that the rainfall now soaks r into the pores and crevices of the earth, formerly it ran from saturated surfaces into the river, when once the shallow ge was filled, and downward filtration pre-d. Whatever force may be due to either ment, this will not account for the phenomena antly recurring of floods, where no floods within the memory of man; and to determine question, finally, would require not only at investigation, but also data and statistics are not yet forthcoming, for the use entific demonstrations. Conclusions vary the character of soil and strata; and observer holds by the result of his own l observations. Whenever it rains for y-four hours, men look to the too familiar s of the daily journal, and read a calamitous f floods in the Midlands, as we were wont to with grim misgivings for a list of "wrecks casualties" after an equinoctial gale. It may at in these days of newspaper enterprise, of al correspondents in every town, endowed with strong imaginations and irrepressible y, nothing is lost in the relation of it to the reader, who scans, with his daily bread, a gue of "moving accidents by flood and field." y shepherd tells his tale of woe to the inter-r, and there is now-a-days a craving for sensa-news which neither existed nor was dreamed the philosophy of our forefathers. It may march of civilisation, but there is no hiding a light under a bushel;" our virtues and our social evils and misfortunes, the incidents ry trade and every occupation, are proclaimed the house-top without reserve or extenu-. It was far otherwise a century ago. The of Yorkshire had abated before their was known in London, and dry land had ared in the valleys of Somerset before the citizens of Carlisle had ever heard of the . In this year of grace, the telegraph re-each harrowing detail with painful iteration.

We are, however, not alone in our struggles to control by human skill the forces of nature; this has been done successfully in Holland, where the people live deep down in the hold of a ship, as it were, ever on the watch for the slightest sign of crack or leak; in Italy, also, upon the plain of Lombardy, the yellow floods of the fruitful Po are curbed, controlled, and utilised for the beneficent purposes of man; and with all our self-glorification as an eminently practical people, it is to these two nations after all that we shall have to look for practical lessons in the art of river conservation. Time fails me to describe how the sturdy Hollander won his birthright from the sea, how he kept it through centuries of toil and persecution; how the floods of Rhineland have become a river of wealth and fertility, and the Rhine delta converted into a luxuriant garden; but they who run may read, and those who aspire to local fame and usefulness, and to serve the State upon these new Conservancy Boards, will find the system of scientific drainage, as developed in the Drainage Unions of Holland, the best model for their imitation. Mr. J. Clarke Hawkshaw has described it in a luminous paper, which will be found in the *Journal* of this Society, vol. xxvii., p. 848. The Government may well take a lesson from that cradle of self-government and independence, by establishing a central department of water engineers similar to the College of the "Water-Staat" in the Hague, of which Mr. Dirks is the head. This department deals with all matters relating to the flow of rivers, and the levels of floods, and controls the drainage of the polders and fens of Holland from a common centre, as Count Moltke directed the operations of a grand army from the table of his bureau; an example in every way worthy of our imitation, which would ensure a succession of trained and experienced men, directed to this particular branch of engineering science.

Practical men have long been of opinion that something like this system of central control should be adopted along the course of our rivers—that every weir and lock should be connected by telegraph, governed from some point of vantage to insure concerted action—so that whenever the approach of a flood be announced, a comparatively empty river would be ready to receive it.

There are yet other causes of flood and inundation, which have not escaped the observation of men like Mr. Parker, of Oxford. One, and not the least important, is the reclamation of the numerous meres, like Oxham Mere, on the Thames, or Whittlesea Mere, in the valley of the Ouse, and the embankment and cultivation of large tracts upon each river bank, which formerly, in times of flood, were always covered; and at other times and seasons were utilised as commons of pasture, for the use of all. Another cause is the silting up of the river channels by the *debris* and detritus which the neglect of past years has allowed to accumulate. To the first I attribute the greatest importance. These meres and marshes once marked the course of every stream as it approached the sea, and became reservoirs for superfluous waters, and safety-valves to the surrounding districts, serving the same purpose as the bosom lands of Holland, which are maintained with the most vigilant supervision for the storage of flood waters in the lowlands around them. Such were

the saltings of Essex, at times covered by the waters of the Crouch and Blackwater, affording, in dry seasons, a precarious pasturage to the neighbouring communities. Where these wide reaches, or ancient morasses, have been reclaimed, embanked, and won from the sea, we find too often the walls and dykes neglected and out of repair, and the storm of the 18th of January has awakened us from a sleep of half a century, and made the inhabitants of some districts acquainted with misfortune who dreamed that they had kept themselves safe from inroads of the sea. Time forbids me to enlarge upon this topic, but the subject is in good hands, and only too ripe for the attention of the Legislature.

In the valleys of the Tame and Trent, large tracts of farm and meadow land have become an inland sea. These rivers, choked with mineral and manufacturing filth, leave behind, when they do retire, a film of poisonous filth to kill the herbage, and infest the soil with sedge and "tussock" grasses, which convert the finest pastures into an unprofitable morass.

Something is being done, we are told, by the Thames Drainage Commissioners, under their special Act, to maintain that river as nature intended it to be—the main drain of the upper valleys; and this brings us to the inquiry so often made in this hall—Why is it that in all these measures of sanitary preservation the metropolis and the Thames are exempted by special saving clauses? In Mr. Magniac's Bill, the Thames, the Lea, the Mersey, the Medway, the Tyne, the Wear, and the Tees, representing well nigh half the watershed area of England, are excluded. The Government Bill is less curtailed in its operations, but both measures are careful not to disturb the rights of the Crown, or the ancient privileges of the Lord High Admiral of the Kingdom. It is, however, to the Thames I would particularly direct attention. There is a mysterious sanctity about this river and the precincts of the metropolis. It is a kind of "Alsatia," like the old sanctuary of Whitefriars, with its benefit of clergy outside the pale of the constitution, and beyond the reach of the common law. In 1848, the metropolis and the Thames were specially excepted in the preamble of the first Public Health Act, and the duties of drainage were confided to the charge of certain Commissioners who have "damned themselves to everlasting fame" by directing the sewage of London and its suburbs to be passed into the River Thames as the best available means of disposing of a nuisance. Twenty years later, the Conservancy Acts were passed to compel the unfortunate victims of misdirected zeal to take it out again, and retrieve, if possible, the ancient purity of the stream. From the Pollution Act of 1876, the Thames and the metropolis were again excepted; and in these two measures now before us, the Thames is exempted, although it is admitted, on all hands, that the Conservators of that river have every power for good or evil, except that which this Act would give them, namely, the means of rating the owners and occupiers who are to be benefited by their operations. The tolls of navigation, and the subsidies of the water companies, do not suffice for all the purposes of the Thames Conservators, and they would gladly have the powers which *these Bills would confer* upon them of providing increased funds for necessary improvements. A it is, the want of means to do good deeds is th ever ready excuse for leaving them undone. certainly cannot be argued that the provisions f the prevention of floods are not required for metr politan waters. Bermondsey and Windsor, La beth and Hampton, would tell a far different ta and the irony of the situation is complete when see the Royal domain of Windsor faring no bet than the squalid dens of Rotherhithe; whilst read in the last official report of the Port Medi Officer of London, dated September 1st, 18 that there are still 348 foul outfalls wi the limits of his district; nearly every one which implies a distinct violation of the Ri Pollution Act. As to the condition of th below Barking and Crossness, the writer of paper has denounced it too often in this hall make it other than a thrice-told tale to audience. It may be stated, in the interest navigation, before we quit the subject of Thames, that the dredging operations of the servators during the past few years have made the lack of water more conspicuous.

Purification.

The last branch of this inquiry is conservation the purposes of purification, and the preservatio fish as food for the people. It is often said purification is a misnomer, that it is impossib purify water once polluted by sewage, and that miles of river flow would not suffice to destr oxidation the germs of infection, where they When I speak of purification, let it be underst that I mean "comparative purification" only. the allegations above mentioned are well foun it would appear to be the logical sequence of opinions held in high quarters, that our r should not any longer be the sources of w supply for the people, and that the Thames Lea must be unfit for the supply of n food. That they are polluted by sewage no can dispute, and in the eyes of sanitary en siasts, the baneful results of that conta tion become more patent every day. But Government measure expressly provides for storage of water for drinking and other purp and the new Conservancy Boards may sell water thus stored from time to time; this at involves the power to clarify and purify as fa practicable the water to be stored, and, co quently, we find that both measures pro for the enforcement of the Rivers Preve Pollution Act, 1876, conferring all the po of a sanitary authority for such purpose. those who know how far that Act has f short of the promise of its inception and enact this is indeed a step in the right direction, an appointment of a free, fearless, and incorru authority to insist upon obedience to that Act redeem it from the reproach hitherto cast up of a lame and impotent piece of legislation. November, 1877, the Local Government Board commended this Prevention of Pollution Act to attention of all sanitary authorities throughout kingdom, but the sanitary authorities turned a ear to the suggestion, and when the Act came into operation at the beginning of 1878, it was found in the rural districts, the owners of small tene upon the Local Boards took good care tha

which they had compounded, should not
nted at the bidding of Government In-
or local sanitarians; whilst in the towns
facturers themselves, who were the prin-
linquents, usurped the reins of local
, and with sullen immobility declined to
rope for their own impending execution.
manufacturers themselves being the most
offenders against the obnoxious Act, it is
r for surprise that they showed no alacrity
ing its provisions. When these measures
the sanction of Parliament, we shall
mentous change for the better throughout
dom. Men above the petty temptations
nterest, and eager only for the common
rich and poor alike, will intervene, under
ts, to stay the continuance of old and to
he establishment of new sources of pollu-
d who can doubt that that intervention is
ely required? Sewage contamination, in
form, is poisoning the fish of every river,
Tay to the Dart, and the precious food of
le perishes, choked by the refuse of cloth
factories run to waste in every river pool.
nures are carried away, and their most
constituents lost in solution in their pro-
wards the sea; and when we reflect that
to the acre is no uncommon dressing in
s of the Thames valley, we contemplate
e of fertilising material with dismay.
nes indeed "matter out of place," and
h was intended to enrich the lands,
y to defile the waters. If this be a
ncident to high farming and scientific
, if this be beyond the help of human
s serious matter for our consideration,
are justified in storing river water, at all
our lower reaches, for the use of man?
and valleys it may be possible to obtain
sufficient purity from the rills and
In this regard, the measures will be
d are worthy of all support. The pollu-
vers, by the refuse of mills and manu-
s, however, the *pièce de résistance* of
progress. It has baffled the energies
plexed the minds of economists,
can paraphrase the celebrated line
et, "Theirs is the respect which makes
) of so long life." Every Government
plunge into the slough of despond, and
inside and outside Parliament have
to postpone the question to a more con-
season. It is not wise to harass interests,
commercial interests, just on the eve of
l Election, and gratitude for political
or favours to come, make men wary of
fence during the existence of a Parlia-
ut the logic of facts is too strong even for
ies, and the Court of Chancery steps in to
the rights of riparian owners, even where
lature halts in providing a remedy. We
notonous tale of injunctions and informa-
he Attorney-General, on every side there
ry for help to arrest the vengeance of the
mills and factories in some of our most
industries have the possibility of ex-
pending over them. From the Calder,
Ribble, from the Medway, and from the
portunate millowners, in their emer-
peal for help—financial and scientific
—to save them from the threatened injunction. Fortunately, it has come to pass in the very nick of time, now that the Government have resolved to enforce compliance with the law, that in the same Parliament which is about to give the powers of compulsion to new Conservancy Boards, a Bill has been introduced, and read a first time, in the House of Lords, which offers a way of escape to those who care to seek it. This Bill is called the Manufacturers' and Millowners' Mutual Aid Association, and our Chairman, to-night, is one of its most zealous promoters, representing as he does interests largely identified with the commercial activity of Yorkshire, and suffering from the pollution of one of their largest rivers. The objects of the Bill are simple, viz., to provide the means for enabling manufacturers and others to comply with the provisions of the Rivers Prevention Pollution Act, 1876. "It is capital we want," say the mill-owners throughout the country, "science and engineering skill alone will not suffice, the experience of the past has taught us to utilise our waste, and we have taken to heart the lesson. We can retain that waste, which is really wealth disguised, if we had the capital to erect the necessary works and machinery; we only want time and the forbearance of the Government for a short while longer to lift us over the dead centre of our difficulties."

The effect upon our rivers, if this resolve were carried into action, would be immediate, and the undertaking of this company becomes, in that respect, an enterprise of national importance. It seeks powers to lend money, and supply the means which scientific skill and experience have disclosed, to keep pollution in the form of mineral and factory refuse out of our rivers, and to convert it to use and profit. The provisions of the Bill are analogous to those of the Land Improvement Act, furnishing a means of judicious investment, secured by the best of all assurances, in the development of our commerce and manufactories, and the improvement of mills and similar premises by outlay of capital to the mutual advantage of both landlord and tenant. The loans will be repaid over a period of years with interest, and the series of instalments will become a charge upon both land and premises thus improved, until final redemption. Such a measure as this is but a corollary to the original Act, and, with the co-operation of the Local Government Department, whose work it is designed to supplement, it will become an instrument in the hands of authority to compel the observance of the law. To Conservancy Boards and other similar corporations it will be a welcome ally, and will afford a ready reply to the manifold excuses which have become the stereotyped apology for every delinquency. "If, sir, you have the will to comply with the Act, there is the way," will be the cogent answer to all such protestations.

We must go back to the times of the Tudors for the first Conservancy Act, and it may be left to the Victorian age to complete the series. We accept these measures gladly for the good that is within them, and as an earnest of still better things to come. Meanwhile these Conservancy Boards, which they propose to constitute, have one distinguishing merit, they are thoroughly representative bodies, based broadly on the will and necessities

of the people, and they will be sustained by co-operation of all classes, urban and rural, for the common good. They will provide for drainage of all lands, high and low, inland or adjoining the sea, and under them the interests of owner and occupier, mill-owner, and merchant, will be equally protected with unity of purpose, and economy of administration. The evil of splitting up the country into partial jurisdictions, and the proverbial fate of divided councils, is thus avoided.

These are great gains, and we hope that the new-born zeal of our legislators will not cool; that Parliament will rise to the height of the great argument, nor stay its hand until the neglect of generations has been repaired.

DISCUSSION.

Admiral Sir Frederick Nicolson, Bart., C.B., as chairman of the Thames Conservancy Board, thought he ought, in justice to that body, to say a word or two. The question was one of complexity, and it was very difficult to make clear in a short time the legal position of the various bodies which had to do with the Thames. The portion of the river above Staines must always be divided from that below, the latter having been in the hands of the Corporation of London for many years; but in 1857, the Conservancy Board was constituted, and that portion of the river was placed in its hands. In 1866, the river above Staines was found to be in such a lamentable condition, that it was necessary to place it in the hands of some governing body, that being the portion where the greatest difficulty with regard to floods arise; and it was then placed under the Conservancy Board, which had an additional number of representative members added to the Board. With regard to the navigation, the Conservators had already spent about £100,000 above Staines, in large repairs and new works; and the locks and weirs, which were crumbling to pieces, had now been nearly all repaired. Simultaneously with this, attention had also been paid, as far as possible, to new weirs, in order to mitigate floods. Only a few months ago a new weir had been built above Henley, which received a very critical examination by a very distinguished officer of Engineers, who had had charge of irrigation works in India, and who acknowledged that it was a most excellent weir for the purpose. But there was always this difficulty, that the moment anything was done which improved the lands above, those below began to cry out for the same advantage, and so they went on from one expenditure to another, until they came to the end of their purse, for money was, after all, the great key to many of these problems. As to navigation, it was quite true, as Mr. Cresswell had said, that owing to the competition of railways, it did not increase as it might; but above Staines it had been much improved. Within the last two years they had placed a steam-dredger on the river, and were gradually clearing away many old obstructions, which no hand-dredger could deal with. Besides the Thames Conservancy, there was another body, called the Thames Valley Drainage Commissioners, which arose in this way. In 1870, the Conservators had a Bill before Parliament, and were anxious to do something to improve the district around Oxford. Owing, however, to reasons which he need not go into, the landowners thought they could do the work better themselves; the Conservators had to withdraw certain clauses from the Bill, and, a year or so afterwards, an Act was passed constituting the Thames Valley Drainage Commissioners. Their jurisdiction extends from fourteen miles below Oxford to a long way above Cricklade. They had had great difficulties to contend with; they had spent a great deal on preliminary surveys, and got *an elaborate report* from Sir J. Hawkshaw, suggesting *an expenditure of £120,000* as the only thing which would cure the evils; upon this they were rath having already rated the owners and occu 4s. an acre for preliminary expenses. At moment, however, the Thames Conservanc correspondence with them, and were not wit that, if some means could be devised for rais something more might be done for that part There was one source of obstruction which t power of dealing with, and that was the old coun which very often were obvious causes of could only say that, as far as their powers went, the Conservators had done their best, ai experienced engineer, to mitigate the evil With regard to purification, there was agai amount of complication. The Conservators powers, but within the metropolitan area, fro to Crossness outfall, the river in that respect control of the Metropolitan Board of Wor Chiswick and below Crossness the powers o servators were very large; and he was gla to say that above the intake of the wate supplying London, there was no sewage f the river. The various local authorities induced, some at a large expense, to const to divert all the sewage, the last works being those at Oxford. The Conservators ha reports from their inspectors, who were visiting the works, and with regard to itself, they were all satisfactory. With re tributaries, there were certain small source tion which they had been looking carefully the last few years, because, under the Act o had power with regard to pollution over the of the Thames to the distance of ten mi almost every instance they had stopped matter flowing into them. But they were points by legal difficulties. Only the othe had a case on the Colne, where they pr that the matter was obnoxious, that it we Colne, and that in four hours, whatever the water, would reach the Thames, yet trates held that they had not proved, in th the Act, that "it was likely to go into the T the summons was dismissed. He did not li on the question of the outfalls at Crossnes had had a very expensive arbitration with politan Board of Works, costing them abou which they were unsuccessful, because they there to the question of navigation, and c directly into the question of pollution. question have been raised before the arb result would have been different.

Mr. Willis-Bund (chairman of the Sev Commissioners) said his Board did not look either of the Bills to which Mr. Cresswell with much pleasure, and his own opini they would make matters worse than before both as a landowner and resident; for as should welcome both measures, as he f must lead to a vast amount of litigation. could not have drawn a Bill more fa the interests of the profession than duced by the Government. One stron was to a new authority being crea that they were already choked with a Drainage Boards, Navigation Commissio Board of which he had the honour to b which did what it could, with limited power to prevent the pollution of rivers. Exper that where there were several distinct would only talk and quarrel, each que authority of the others. He objected bot stitution of the proposed Board, and to the given to it. The Bill stated that due pro be made for the representation of owners, possible to have a Board with no owners while at the same time they were to pay the

rork. There must, in fact, be a large amount of ı, and very inadequate representation. He also ı to the classification of lands. He could under- wo classes of lands—those which were benefited, se which were not; but he could not understand ı class between the two. Of course, all those were benefited ought to contribute to the s, but it was impossible for a Local Govern- Board Inspector to divide a watershed like that of ren in a satisfactory manner into these three s. In the midst of the uplands, there were lands ith floods, and in the lowlands there were portions h were not damaged by floods, and these ought to ed with the uplands. Again, the Bill pro- t to give power to tax every acre of land in ntry—because all land was in some water- and that was, in his opinion, a power which ought be given. What was wanted was a power to set at once to clear streams, and get rid of floods; e powers proposed included the storage of water and the construction of arterial drainage. As to ter, he contended that it was a separate matter ther, and the former ought to be left to private tie. He thought the powers given should ited in the first instance to inspecting and ng, and calling on the owners to do the ry works, and in default the Board might do In addition, some system of communication, had been suggested, by which preparations made in time for getting rid of the surplus ould easily be devised. But instead of that a re ambitious scheme was prepared, which would deal of litigation and expense, much of which thrown away. He had seen many attempts out the Rivers Pollution Act, and he quite d the necessity for some public body being for doing this, but here the Bill fell far what was required, and he hoped when ed from committee it would be considerably , so that the Board might act in a more summary nething like an injunction in Parliament to stop ution. If you had to write to the Local ent Board, and take first one step and then before doing anything, the mischief was done. s a town near the source of the Severn where ollution was taking place, filling up the bed of , and his Board determined to take proceedings, he first place, they had to give the offender two notice. He replied, that in two months he ave done all he wanted. When the time was took proceedings in the county court, but the was then done, and as the county court judge d the case for two months more, in order to the Acts of Parliament, he advised his Board to iise the matter, and not spend any more money t was already done. What was wanted was interfere sharply and decisively when a pollu- being committed, or about to be committed, ly to enter into a long correspondence with the vernment Board.

Wolstencroft thought it would tend to the pre- f floods if the rain-water which fell on each re utilised for domestic purposes, which might by rejecting that which fell first and washed impurities.

I. Noel asked Sir Frederick Nicolson if the f Reading, Windsor, Oxford, and other towns hames did not pass into the river, what became

Nicolson said it was disposed of chiefly by a. The solid particles were applied to the land, Conservators had a careful investigation made overflow which might pass in. They were by the chemists, who analysed any samples hich there was any doubt, that they were ly pure to go into the river.

Mr. Noel said he was one of the Conservators of the River Lea, and he might make identically the same statement as the chairman of the Thames Conservators had made, with regard to the Thames above the intake of the water companies, and in the same sense. He hoped, therefore, Mr. Creswell would be able to withdraw the statement he had made about the water of those rivers not being fit for the consumption of the metropolis.

Mr. G. J. Symons, F.R.S., said he was sure Mr Creswell would agree with him that 1880 was not by any means the first year in which floods had been conspicuous. There had been half a dozen exceptionally wet years, which led to exceptional floods, but he hoped it would be recollected in the House, that this was only a temporary phenomenon, and that there was no reason to suppose that the distribution of the rainfall had permanently changed from what it had been for the last 150 years. In all probability, just as they had had successions of dry years and of wet years in the past, so it would go on in the future, and he hoped the arrangements now proposed would not go too exclusively on the hypothesis which just now prevailed, that water was a nuisance, or they would soon be crying out in the opposite direction. In 1868, there was a terrible outcry, especially in the Midlands, that no end of damage had been done by draining too much, for the land was so dry they could not get any grass to feed the cattle. He was very glad to see the announcement in the *Times* with regard to the completion of the Ordnance Survey, and could not understand why there had been so much delay, unless the Department had been devoting too much attention to the survey of Palestine and the measurement of the Pyramids, and neglecting duties more important nearer home. He did not agree that railway communication had rendered water navigation useless, and hoped it would not be the case, because the competition of canals was most important as a check on the charges of railway companies. There was no doubt it would have been much better if London had been sewered with smaller sewers; but, after all, he did not think Londoners would like to see the whole of the rainfall, with all the filth from the streets, following merely the natural channels, which meant, he supposed, down the sides of the streets. If such were the case, it would not be very pleasant to cross Pall-mall, with all the filth from Regent's-park, Portland-place, and Regent-street running down. He did not pretend to be lawyer enough to have gone through these Bills carefully, but, looking at it as an outsider, he thought they would come to grief over the question of rating. As was generally the case, local and personal interests would come to the front, and, instead of fighting the matter on the engineering merits, it would be fought out on the question whether parties should pay a high rate or a low one. One thing, however, seemed to be overlooked, that the highlands were the real sinners; they produced the bulk of the water, and why should not they help to pay for getting rid of it. There was no doubt in his mind that, if the rivers were properly cleared out, a much more rapid discharge for flood-water would be provided. Again, in old times, it was understood that much land on each side of a river was wash-land, liable to be flooded, in times of wet weather, but now-a-days people built upon this land, and then raised a great outcry when they were flooded. He was glad to hear the suggestion as to opening sluices, &c., and having telegraphic communication at the different weirs, and locks for that purpose; it was one he had made some years ago, but it was only following the example of the French, who had done it long ago. But even assuming the river to be quite free when a flood came down, it would not make so very much difference. The Thames Conservators were always wanting funds, and he hoped some means would be formed for giving them larger means to carry out their operations. As to the fish, he

thought Mr. Cresswell must be a fisherman, or he would not attach so much importance to this point, for any amount of food they might obtain from the Thames in this way would be as nothing compared to the quantity which was constantly thrown away, simply for the purpose of keeping up prices at Billingsgate. Mr. Bund had objected to landowners being taxed to provide water-storage, but on the other hand he had heard complaints that those at the head of a river would be able to store up the water, and to sell it to towns lower down at a profit.

Mr. Baldwin Latham agreed that the multiplication of authorities, as proposed by the Bills referred to, would not tend to a useful result. On the other hand, there were great objections to giving conservancy powers to urban and rural sanitary authorities, they being the chief sinners with regard to pollution; and any Central Board elected by the minor Boards would be open to the same objection. The question of taxation would be a very difficult one. It was quite true that the highlands were the flood producers; Sir J. Hawkshaw's rule was that the rainfall increased 3 per cent. for every 100 feet of elevation, but, in 1879, the rate of increase in many places, according to his own observation, was 10 per cent., and scarcely anywhere under 6 per cent, which gave some idea of the enormous amount of floods in that year. Last year the increase had not been so great. But though this was true, the lowlands were valued, taking the contingency of floods into account, and, therefore, if the whole area were taxed, the lowlands would be benefited at the expense of the others. Therefore, in any public measure for improving the lowlands at the general expense, the Conservancy Boards should have power to acquire all lands at the present rental, so that hereafter the district which was to be taxed should have the benefit of the improvement, and not allow them to be pocketed by the landlords. The pollution of rivers was a matter which demanded urgent attention, and though they had heard that the Thames was entirely free from pollution, he thought the statement must be accepted with some reservation. People had very different notions as to what constituted pollution. On the River Lea the works were not so perfect as in the valley of the Thames, but even there, in many places there were large traps and overflows, called storm-water overflows, which in times of heavy rain discharged the sewage of the district into the Thames. There were also many tributary districts, which at the present time were undrained. This question of purification was of great importance, though it was much lost sight of in rainy seasons, these being the most healthy. In fact, the health of London was in proportion to the quantity of water which passed down the Thames. The Bill to which Mr. Cresswell had alluded, in which he was in some degree interested, was intended to put manufacturers in the same position, with regard to utilising their sewage and refuse, as local authorities were, giving them power to borrow money for the necessary works, and spread the payment over a number of years.

Sir F. Nicolson said he was quite aware that there were many storm overflows within the metropolitan area; and there, no doubt, sewage came into the river; but, as far as he knew, there was nothing of the kind above the intakes of the water companies.

Mr. Peregrine Birch said the Government Bill ought to be called "The Surface-Water Disposal Bill," for at present no power existed for any authority to deal with the surface-water; and that and the sub-soil water was the great difficulty. Some such measure as that now contemplated would, therefore, be of the greatest use; and it would be advisable not to make the district too large; for it was very difficult to get a large area of one opinion. If the rural or sanitary authorities were not large enough, they could combine, as they did for sanitary purposes. He should certainly advocate po[illegible] given to an authority for a part of a basin for a whole basin. He did not believe in the ment of lowlands, midlands, and uplands, but divisions were made should be arranged befo[illegible] trict was formed, or, as soon as they began who should pay, the majority of the ratepa[illegible] come to the conclusion that no work a[illegible] necessary. He was pleased to hear, on the of Mr. Sewell Read, that subsoil drainag[illegible] increased floods, for that had always been hi[illegible] He had no doubt, either, that a great de[illegible] belief that floods had so much increased of was owing to the improved methods of comm[illegible] for there were records of floods 50 and 100 years as high as anything we have had lately, and area covered must have been as large. H[illegible] think much would be gained by telegraphi[illegible] had seen boats rowed up the Thames over so that if they were removed altogether it make any difference in the level of the water. sketched out five clauses for enabling sanitar[illegible] ties to conctruct works for the removal of s[illegible] subsoil water from their districts, which he should be added to the Government Bill.

Mr. Cutler remarked that one point of so[illegible] ance had not been touched upon at all, viz portance of rivers as a source of power. Fr[illegible] to Teddington, there was a fall of 70 or 80 fe[illegible] power thus at command was utilised to so[illegible] but not nearly so much as it might be.

Mr. Grantham said he was appointed a[illegible] under the Land Drainage Act of 1861, and he had inspected many districts, where quest[illegible] this Bill dealt with would arise. The provi[illegible] very complicated, and his experience led him they would not work. At the end of his ev[illegible] fore the Lords' Committee, in 1876-77, were one of which classified all the rivers of E[illegible] cording to their areas, and they varied from square miles to three. The medium-size[illegible] would be comparatively easy to deal wit[illegible] very large and very small ones would pr[illegible] difficulties; the small ones would ha[illegible] amalgamated, and the larger ones div[illegible] was the inspector appointed to fix the of the Upper Thames Valley Drainage; a [illegible] made on the 25 inch scale, which was reduced, and a contour line was put on it 5 the highest known flood, and that was fi[illegible] limit. As to the taxation, there was a gre[illegible] made in the Bill, the true principle being lands according to the amount of benefit de[illegible] the works undertaken. In Ireland this was by a valuation of the land before and after, [illegible] this would be very expensive, still it might the aid of local knowledge.

Mr. Cresswell, in reply, summed up th[illegible] points in the discussion, with most of which and he expressed himself much gratified t[illegible] everyone who had taken part in it was a rep[illegible] man. He was much delighted at the state[illegible] by Sir Frederick Nicolson, in which he wa[illegible] by Mr. Noel, but he thought those gentle[illegible] little too confiding. If inquiry were made [illegible] owner on the Kennet, just where that river [illegible] Thames, near Reading, as to the condition o[illegible] after a heavy rain, he did not think his re[illegible] be so satisfactory as to the perfection of the se[illegible] Mr. Bund was quite right in saying there [illegible] enormous field for litigation, and that he avoid. With regard to the Lea, he heard at ton inquiry, the evidence of Major Lamro[illegible] who lived in the Lea Valley, and he gave satisfactory account of it, and talked of "b[illegible] which was a polite phrase for certain sl[illegible]

nes opened at night, when the Conserva-
t on the look out. He admitted the force of
i's objection to the whole of the filth of
ts being washed down the gutters, but that
t by proper scavengering, and, in practice,
rater would not be carried in open gullies,
red channels much smaller than the *cloaca*
existing. There was no doubt, as Mr.
nted out, that a great deal of the outcry
ls arose from people's own folly in building
situations. For instance, Nottingham, 100
ad 7,000 inhabitants, and now had 120,000,
of whom lived in rows of dwellings along
the Trent, built on land which was for-
d half the year. As to the fish, he quite
the disgraceful proceedings now common
be stopped, but when that and all other
abolished, there would be no need to have dis-
hat room any longer. Mr. Latham's valuable
s to storm overflows showed the importance
g the rainfall from the sewage wherever
it was from these storm overflows that the
of contamination were derived; and the
f the Thames were not by any means so
Conservators imagined. However, when
of the decision of the magistrates at Ux-
could only wonder how any Board could
s duties. Mr. Cutler had certainly called
an important omission, but, as had been
beginning of the paper, he had been obliged
at deal he should have liked to bring forward.
ies connected with taxation to which Mr.
ad alluded were present to his mind, and
efore, suggested that they should be ad-
rliamentary authority, and not left to local
d disputes.

nan moved a vote of thanks to Mr. Cress-
was carried unanimously.

MISCELLANEOUS.

DUCING BOMBYCES REARED IN 1880.

By Alfred Wailly

auréat de la Société d'Acclimatation de France).

been seen in my report, published in the
he *Society of Arts*, Feb. 13th and March
the cold weather in 1879 had the most
fect on the rearing of exotic Lepidoptera.
fine and warm weather we had during the
igust and part of September allowed of the
aring of several species in the oper air; but
wet weather, lasting till about the end of
e same effect on most species, as in 1879.
of *S. Promethea*, for instance, which gener-
at the end of June and beginning of July,
emerged before the end of August; one,
emerged on the 7th of September. Except-
the Indian species did not emerge at all.
selene moths were obtained at intervals; the
ined in the pupa state. No pairing could
The same failure attended *Attacus mylitta*
race), of which I only obtained nine moths,
th of August to the 7th October, giving me
of obtaining fertile ova. A singular fact
ttacus mylitta is, that some cocoons placed
se at a gardener's, in April, did not produce
ill August, too late to rear this species, if
ould have been obtained.

d of February, 1880, I received from Cal-
coons of *Attacus mylitta* (Himalaya race),
f which had died in transit, but none had
ater on, April 19th, I received from Major
Coussmaker a tin box containing 100 *Mylitta* cocoons of the Bombay race, more than two-thirds of which had emerged on the way. The tin box had evidently been kept in too warm a place, and the metal had quickly communicated the heat to the cocoons. From the remaining cocoons of this Bombay race I obtained several fine moths, from the middle of May to the beginning of July, but, as with the Himalaya race, no pairings took place, the weather being too unfavourable. I had to keep them in a room.

For two years I have had a series of disasters, owing to various causes. The greatest difficulty is to obtain the cocoons alive from abroad; the next great difficulty is the struggle against the climate, which has been my greatest enemy here during the last two years. Artificial heat, unless pure air and a free ventilation can be obtained at the same time, cannot replace natural heat. The reverses experienced during the last two years in my attempts to reproduce and rear these splendid silkworms and other Lepidoptera have been beneficial to me in one respect—they have given me valuable information, which I should never have acquired had everything succeeded according to my wishes, although I sincerely hope these fatalities will not occur again, at least on such a large scale.

The species of silkworms which I placed on trees in my garden during the magnificent month of August, were *Cynthia*, *Pernyi*, *Prometheus*, *Cecropia*, *Polyphemus*, *Luna*, and *Pyri*.

The *Cynthia* worms thrived remarkably well on the Ailanthus trees; so did a few *Promethea* on a small lilac tree, the first time I tried the latter species in the open air. I never remarked that the sparrows destroyed any *Cynthia* worms; the *Promethea* worms (a very closely allied species) were equally spared by them. But it was not so with respect to the other species, of which the sparrows made a wholesale murder this last summer (1880). Excepting the year 1879, when the rearing of most species was absolutely impossible in the open air, I had previously succeeded in obtaining cocoons of several species besides *Cynthia*, although I could not protect them from their terrible enemy, the sparrow.

My object in thus rearing, or attempting to rear, these silkworms on trees in the open air, is, of course, to test what we call their *rusticité*, i.e., their hardiness or capacity to resist the English climate; but birds must certainly be guarded against.

Actias luna (North America).—This species I bred this year for the first time, and I obtained a complete success. I think it is one of the easiest species to rear. The larvæ were fed on walnut, some of them being kept under large bell-glasses, till they formed their cocoons, which are of very thin texture. This species is of no value as a silk producer, and cannot be called a silkworm, but it is very beautiful; the perfect insect, like the Indian *Selene*, resembles a swallow-tail butterfly of a yellowish-green; it is smaller than *Selene*. Other *Luna* larvæ thrived equally well on a nut tree in my garden, with *Polyphemus* and *Cecropia*, but, as stated before, the sparrows destroyed them all, when in the third and fourth stage. I had a large quantity of *Luna* cocoons from America, and the moths emerged from the beginning till about the end of June. I obtained twelve or thirteen pairings. In the first two stages there is a striking difference between the larvæ of *Actias luna* and those of its Indian congener, *Selene*. *Selene* larvæ in the first stage are dark red, with a broad black band across the middle of the body; in the second stage, they are of a lighter red, without the black band; in the other stages they are green like *Luna* larvæ. *Luna* larvæ are green in all their stages; in the first stage, of light or whitish green. When large, the tubercles on *Selene* larvæ are bright yellow, and on *Luna* larvæ, of various shades of red or crimson.

Attacus aurota (South America).—On the 5th of June, 1880, I received from French Guiana a box containing

82 cocoons of this splendid species (the South American *Atlas*), and 18 smaller cocoons of a species called *Bombyx hesperus*. The latter had all been attacked by dipterous parasites. The cocoons of *Bombyx hesperus* are similar in shape and size to those of *Cynthia* (the *ailanthus* silkworm), but they are of a much darker colour. The moths of *Attacus aurota*, of a rich and silky brown, with a triangular window on each wing, are smaller than most of the various races of *Attacus atlas*. The *Aurota* cocoons, of a brilliant golden or silvery silk, are open at one end, and similar in shape to those of *Atlas*. A certain number of the *Aurota* moths had emerged during the voyage, but the remaining live cocoons were in good condition, and produced from the 12th of June to the 19th of August, splendid and perfect moths, which unfortunately refused to pair, the weather being too cold for this equatorial species. On the evening of the 2nd and 3rd of July, the weather being then very cold, a fire was lighted in a large room in which I had a number of cages containing *Aurota*, *Mylitta*, *Selene*, and other moths, but all to no purpose for these three species. At the "Société d'Acclimatation," in Paris, they also failed to obtain pairings from the *Aurota* moths which had emerged from the cocoons I had sent to the secretary of that society.

Attacus aurota is found in Brazil, and, very likely, all over equatorial America. Various names are given to different races of *Aurota*, as if they were distinct species. *Attacus speculifer*, found in Brazil, is so much like the true type *Aurota*, that it seems but a variety, if it be even a variety. My own *Aurota* (Guiana race) is rather more like *Speculifer* than the one given as the true *Aurota*. All three, in my opinion, are one and the same species. This multiplicity of names is sometimes bewildering. At the British Museum, for instance, among the Indian species of the genus *Actias*, we find *Actias mænas* and *Actias leto*, side by side, it is true. Now these, according to an experienced American entomologist, Herman Strecker, are the same species: *leto* is the name given to the male, *mænas* that given to the female. The male is blotched all over with reddish brown, the female is plain green, at least such as I remember to have seen.

The *Aurota* I received has, every year, six generations in French Guiana. Such is the effect of equatorial heat on these insects, whose life is as ephemeral as it is active. How different from insects found in cold countries, which sometimes require three years to reach the perfect state! I have seen cocoons of Indian species, such as *Mylitta* and *Selene*, hybernate twice, and even three times, under the influence of the English climate.

To conclude this notice on *Aurota*, I will translate and quote a few passages from my French correspondent's letters:—"In our French Guiana we have five distinct species of silkworms, but I only have time to rear two, which I do on a hedge in my garden. Our silk-producing larvæ, have regular, pacific habits, which make the rearing easy and attractive. The *Aurota* moths emerge one month after the formation of the cocoon; the pairings here take place in the open field, and the females lay over 600 eggs each; eight days after the larvæ hatch, and in 20 days the cocoon is formed. *Bombyx hesperus* forms its cocoon 15 days after the hatching of the larvæ, and the same operations are renewed every 60 days for *Aurota*, and every 52 days for *Hesperus*. We can therefore produce six crops of cocoons every year, and these crops would have no other limit but the extent of the plantations, the foliage of which is renewed twice a year. So, you may think, how inexhaustible would be such a production of silk, if a European company seriously took this industry in hand. *Bombyx hesperus* and *Attacus aurota* live on the same trees, and both will live, I think, on the *Ailanthus*, *Aurota* lives here also on the orange tree, and on the *Eucalyptus*."

Attacus atlas.—In 1879, Mr. P. H. Gosse, F.R.S., of Torquay, published a long and interesting memoir on *Attacus atlas*, in which a very minute desc given of the egg, the larva in its six ages, of the cocoon and pupa. Herr L. Huesmann berg, in Hanover, has also written a memoir which has appeared in the "Isis" of Berlin 19th, and 23rd of September, 1880.

In one of my reports on silk producers, I that, in the year 1878, I had a quantity of li of *Attacus atlas*, but the moths having com emerge in the middle of July, when I was start for Paris, I was unable to rear this sp 1879, I had no cocoons nor ova of *Atlas*, bu a French correspondent sent me sixty-five the middle of August. The season being th advanced to give me any chance of rearing here, I sent the ova to two correspondent Continent, keeping only twelve, to see when would hatch, and how long they would live un glass. Both my correspondents failed to ol satisfactory results. One stated that the ov hatched, the other wrote to me that half of the not hatched, and that the larvæ obtained had a very short time.

With my twelve ova, I obtained five larv hatched on August 22nd. Three died in first a stage, but the other two, strong and health splendid condition on the 6th November, w were sent for preservation. The weather h very cold, the foliage might have failed at an and the larvæ were too far from the spinning give any chance of obtaining cocoons; they in the fifth stage from the 5th of October (32 showed no sign of entering into their last slee to passing into the sixth and last stage. The l fed on a superior species of the common (*Berberis vulgaris*), with large thick foliage. I found the best for them. The different st place as follows:—First stage commenced on August, the second on the 2nd of September, on the 10th of September, the fourth on t September, the fifth on the 5th of October. were five days in sleep before passing into the in which they remained as above stated—32 da bred in 1878 by Major Lendy, of Sunbury-on were only one month from the time of hatchi formation of the cocoon, but they were in a h

The larva of *Atlas*, when hatched, is bl long, white, soft spines. In the subsequent larva appears almost entirely white; this is white powder, which covers not only the tub the greater part of the body, thus rendering tion of the larva rather difficult. In the se third stages, the colour seemed orange on the the body from which no farina was excret larva of *Attacus cynthia* (ailanthus silkworm covered—but not so thickly—with a white fa last stages. On removing the powder, the sk larvæ is green. Having only two atlas larvæ, not remove the powder, to see their colo feared to run the risk of injuring or killing t is the case with other species, there are si spines on the larva, the two rows on the top o being the longest; the two lateral rows are v and almost filiform. The farina on the four is so thick that they look as if covered with l In the fifth stage, the larva seemed of a green, the tips of the spines blue; the anal which is blue, with small black spots, has on an orange-red ring. This is a very short and description of the *Atlas* larva, but a compl found in Mr. P. H. Gosse's "Memoir on Atlas Moth of Asia." From a letter just r hear that, in 1880, Mr. P. H. Gosse had a success in the rearing of *Atlas* larvæ, from ov in June, the result being a number of fine coc

Attacus Pernyi (North China).—This most oak silkworm, now thoroughly acclimatised

is double-brooded, has been extensively reared nited States of North America, during the year om live cocoons I sent to various parts. A ndent in Illinois, writes that it was doublethere, and that he found some of the worms had left oak trees, the foliage of which had bey and tough in consequence of the hot, dry,), feeding on hawthorn bushes, growing close oak trees. Other *Pernyi* larvæ were found on rees in a garden, where they reached an enorize. In France some were reared successfully n. According to a statement of my Spanish ndent, *Pernyi* is essentially an oak feeder, which erate after a time, if fed on other trees than

(*To be continued.*)

HOWA" OR "MAHWAH," AN INDIAN FOOD-TREE.

By C. G. Warnford Lock.

problem of ensuring a sufficient food supply for millions, cannot yet be said to be satisfactorily though much has been done to avert future . Some remarks upon the *Singhara* nut, a highly nt article of diet among numbers of the natives , appeared in the *Journal* of January 31st, 1879 67, vol. xxvii., p. 174). An equally deserving s the produce of the *mhowa* tree.

ame *mhowa*, which is spelt by Europeans in at ozen different ways, is applied, it would seem, to *Bassia latifolia*, the most important species, to *B. longifolia* and *B. butyracea*, whose fruits ise edible. The singularity of the genus cone fact that, besides offering eatable fruits, their ciduous corollas are largely employed for the pose, and in point of fact, constitute a staple, times almost the only, article of diet available ower classes of Indian natives during several of each year. *Bassia latifolia* is abundant in of Central India, and is cultivated in many tricts.

ds the end of February or the beginning of s the crop of flowers approaches ripeness, the becoming fleshy and turbid with secreted juices, y loosen their adhesion to the calyx, and fall to nd in a snowy shower. The duty of collecting n blossoms is chiefly performed by women and ; at dawn, they may be seen leaving their with baskets, and a supply of water for the . Before the crop has began to fall, they take asion to burn away the grass and leaves at the he trees, so that none of the blossoms may be when they fall. The gleaners generally remain e trees all day, alternately collecting the crop ing, and the male members of the family visit once or twice during the day, in order to carry at has been collected. At night, bears, deer, r animals visit the trees, to take their share of

At early morning and late evening, the less d trees, on the borders of the jungles, attract of jungle-fowl and pea-fowl. Cattle are also d of the flowers, and cows' milk has in conset this season, a strong flavour of *mhowa*.

n happens that the collectors come a considernce, in which case they erect, with the branches tree (*Shorea robusta*), a temporary encampment n which they live until all the crop is gathered ront of each of these huts, a piece of ground is te smooth and hard, for the purpose of spreadhe flowers to dry in the sun. When perfectly have a reddish-brown colour, and are reduced a quarter their original size, and half their weight. It is a custom with some of the before spreading the flowers out to dry, to pull ng of minute foliaceous lobes which crowns the fleshy corolla. It is very difficult to obtain any trustworthy statements as to the yield of the trees. A firstclass tree, it has been said, will continue to shed its blossoms for 15 days, at the rate of 120 lb. a day; but this estimate is probably double what it ought to be. The rent of trees varies with their abundance in the district, the quality of the preceding rice harvest, and various other circumstances bearing upon demand and supply. The extreme prices ascertained by Mr. V. Ball, of the Geological Survey, to have been paid for permission to collect, in various places, were 2d. and 4s. The saved crop varies equally in price, the extremes being 120 lb. and 480 lb. for a rupee (2s.); but when, as is most frequently the case, the exchange is made in kind, the merchants give only a small quantity of salt, and 6 to 8 lb. of rice, for the maund (80 lb.) of *mhowa*. During the famine in Manbhum, a rupee would purchase only about 24 lb.

Some authorities state that two maunds of *mhowa* will furnish a month's food to a family of two parents and three children. It is, however, seldom eaten alone, being mixed with the seeds of the *sál* tree (*Shorea robusta*), or with the leaves of jungle plants; sometimes a small quantity of rice is added. When fresh, *mhowa* has a sweet taste, with an odour somewhat suggestive of mice; when dried, it presents some resemblance to inferior kinds of figs. Cooking renders it vapid, and utterly devoid of flavour. On distillation, the newly-dried flowers yield a highly intoxicating spirit, called *daru*, which is generally diluted with five to ten times its bulk of water, and is then sold at the rate of about 1d. a quart. Its odour is most offensive to Europeans, but British soldiers have been known to secure intoxication by drinking it with held noses. By careful distillation, it is possible to get rid of the essential oil which causes the unpleasantness. As much as six gallons of proof spirit have been got from one cwt. of the flowers. The rectified spirit, when placed in oak casks, takes a yellowish colour, and is preferred to high-class Irish whisky. Analysis shows it to be wholesome. From the seeds, is expressed a kind of oil, which is used for cooking purposes, for admixture with ghee (clarified butter), and for lighting and soap-making.

The tree thrives in poor stony ground, and might, therefore, be cultivated on land not available for other crops. Though the natives protect such trees as exist, they do not seem to take any steps to increase the number. The yield of flowers is proverbially regular from year to year. When dried, they will keep for almost any length of time. The large proportion of sugar (50 per cent.) contained in them has attracted the attention of agriculturists in this country, who see in them a valuable cattle food; and Messrs. T. Christy and Co., of Fenchurch-street, are already importing them for that purpose.

DRY FOGS.

Mr. John Aitken, of Darroch, Falkirk, has made a large number of additional experiments on the formation of fogs since the reading of his paper on "Dust, Fogs, and Clouds" before the Royal Society of Edinburgh, in December last. He then showed that particles of watery vapour do not combine with each other to form a cloud-particle, but that the vapour must have some solid or liquid body on which to condense. Vapour in pure air, therefore, remains uncondensed or super-saturated, while dust-particles, in ordinary air, form the nuclei on which the vapour condenses and form fogs or cloud-particles. The main conclusion which the author drew from his original experiments was that, "if there was no dust, there would be no fogs, no clouds, no mists, and probably no rain, and that the super-saturated air would convert every object on the surface of the earth into a condenser on which it would deposit." During the present month, he read a paper, illustrated by experiments, before the

Philosophical Society of Glasgow, on "Fogs and Atmospheric Dust," and in the following week he communicated a paper on "Dry Fogs" to the Royal Society of Edinburgh.

From experiments which the author had made, he had drawn certain conclusions, which were thus summed up:—1. That as regards quality and foggy condensation, there was dust and dust. Some kinds of dust had the power of determining condensation in an atmosphere which was not saturated air; and from other experiments it was probable that some degree of supersaturation was necessary before some other kinds of dust were active. In highly supersaturated air all kinds of dust would form nuclei and determine cloudy condensation, but in unsaturated air only some kinds were active. 2. That dry fogs might be produced by some form of dust in the air, such as sodic chloride (common salt), thus condensing the aqueous vapour in the air which was not saturated. 3. This condensing power or attraction which some kinds of dust had for aqueous vapour explained why our breath and condensed steam dissolved even in foggy weather. 4. That as the products of combustion of sulphur determined the condensation of water vapour in unsaturated air, and gave rise to a very fine-textured dry fog, they were probably one of the chief causes of our town fogs, as they had a much greater condensing power than the products of the combustion of coal. It was not claimed that Mr. Aitken's experiments proved that dry fogs in the country were produced by salt dust. The experiments only proved that salt dust could produce a dry fog. In a note appended to his paper, Mr. Aitken added that since making the experiments which had been described, the fog-producing powers of the products of highly heated chloride of magnesium had been tested, and were found to possess a much greater fog-producing power than any other substances with which he had experimented.

GOLD MINING IN JAPAN.

The Vice-Consul at the port of Niigata, in a recent visit to the gold mines, which are situated at Shimo Aikawa, on the upper slopes of a valley extending down to the shore through the town of Aikawa, states that these mines were first discovered in the year 1613, in the time of Iyeyasu, and have been steadily, though slowly, worked by manual labour till 1869, when the Government determined upon applying the foreign method of mining. Machinery was constructed, and in 1872 was in full working order. Three mines are now being worked—those of Ogiri, Torigoi (a quarter of a mile distant from Ogiri on higher ground), and Aoban. Gold and silver are found in all three, but copper prevails in the first two. Torigoi and Ogiri are imperfectly connected by a gallery, 3,000 feet in length, and a tramway between them is shortly to be laid down. The main shaft is sunk to a depth of about 600 feet, and is situated between the three. As the ore is brought up from the mines through the shafts, it is carried in trucks to sheds, where it is picked by women and classified into four kinds, thence it is conveyed on women's backs to the works, at the rate of 23 cents a ton. A tramway originally connected the mines and the works, but it was partially destroyed by a storm some years ago and has never been repaired. A new road for tramway and bridges, however, is in course of construction. First-class ore generally contains from 50 to 2,000 yen worth of gold, silver, and copper per ton. This ore is crushed, reduced to powder by the stamps, and ground up with mercury into an amalgam (the latter process taking eight hours). This amalgam is distilled and afterwards made into gold and silver ingots. The tailing or refuse parts of the amalgam still contains some metal, to the value of 15 to 20 yen per ton, and is sent to the concentrating tables, where the gold, silver, and copper are concentrated. T centrations are afterwards sent to the smelti where the ore is reduced to crude black cop action of heat. After the sulphur has been by calcination, the crude mass is melted in fla with the addition of lead. The lead sinks to t of the furnace with the gold and silver, and is left behind. The smelting process is repe or four times. The lead is collected into a ma 20 tons cupelled by German furnaces, and lapse of 50 to 60 hours, bullion is extracted made into ingots of 5 to 700 oz. weight. ing is done at Osaka. Second-class ore cont 30 to 50 yen worth of metal per ton, and is bullion by the same process as the first. fourth-class ore are first crushed, made fin stamps, and subsequently concentrated by t The concentrations are then reduced by smelt amount of gold and silver produced in the ye amounted respectively to 2,195, and 91,713 our Adachi, the superintendent of the mines, stat total loss to the Government in working the a period of ten years, ending 1879, has bee yen (about £50,026). This amount, how Adachi hopes to reduce in a few years. He erect a new steam-engine of 50 horse-power, and 6 amalgamating pans, and to make othe ments, the total cost of which he estimates yen (£17,291). The annual production is be about 420,000 yen (£87,500), and the wo penses 300,000 yen (62,500). The persons e the mines number 1,080, including 120 wom picking. Miners working eight hours a day cents, and the average wages of miners pe six months, has been 18 sen 3 rin (about women are employed for carrying ore, and the workshops. Skilled workmen receive 2 day of 12 hours, while in Tôkiô men doing si receive 40 to 50 cents. Inferior workmen cents. The average wages of workme months, have been 14 sen 7 rin per day (There are 41 overseers, including one sup one foreigner, six engineers, and four cl daily output of ore is about 20 tons, and abo quantity is reduced. The total expense of r ton, amounted, in the year 1879, to 21 yen 7 £4 7s.). In the percussion tables about 10 t duced in 24 hours, and in the amalgamating 9 tons daily. In addition to the mines of Og and Aoban, gold has also been found in sma at Takinosawa, about 12 miles from Aik alluvial deposit of the bed of a river, and als Mikawa.

CORRESPONDENCE.

TRADE PROSPECTS.

In the Society's *Journal* of the 4th inst., of p. 193, Captain Bedford Pim, R.N., a authority in matters nautical, is report said that "owing to the repeal of the Navig 80 per cent. of our seamen were foreigners."

In the *Times* of the 7th inst. (p. 8), I read melancholy heading of "Disasters at Sea British vessels had been reported wrecked previous week (one of such vessels having b another 41 years old); that the total numbe British and foreign, for the present year more than five weeks old) had been 295; th had been lost, and that the approximate va perty lost had been £5,200,000, including British.

In the *Times* of the 11th inst. (p. 10), als

ing title of "Disasters at Sea," I read that *Veritas* reports, in part of 203 vessels of all (including, however, 16 missing) in December nglish sailing vessels and 12 English steamers. cause and effect be discerned to some extent eral foregoing statements? Is there no contween the "Babel of tongues" and nationhich must exist on board our ships, when fourhe sailors are other than British (supposing the nd learned ex-member for Gravesend to be his assertion), and the loss in 9 or 10 weeks ? × 93 + 12 = 127 British vessels above re-, and the loss in about five weeks of four rling of British property?

n, 80 per cent. of our merchant seamen are n, how, in the event of a great naval war, could ate and reliable supply of British A.B. seamen t of the odd 20 per cent., to fill up, on the the complements of men required for the ships oyal Navy, and to man, and to fight, if need reat merchantmen?

hermen, and life boat, and coast guard men le set of fellows, but could they be spared n our shores in the event of such a war? And d our great carrying trade be safely con-

not something rotten in the present state of d are not the enormous losses, as well as the iums paid for marine insurance, really borne me-tax (so to speak) on commodities by the ring British public? Would it not be instructurn were made by the Board of Trade of the spectively, of British and foreign sailors on of every British vessel which should be seriously damaged? A SALT'S SON.

GOLD IN INDIA.

attended the meeting on this paper, held on e 11th instant, I beg to make the following s on the question of labour, raised during the :—

would, in my opinion, be a mistake to send number of Cornish miners to India, as they a deal of trouble, and do little work. Nor ary to do so, seeing that native Wuddars can l, who are skilled in the use of jumpers and in blasting operations, also in the splitting of nd rocks by hammers or rows of wedges, and quickly understand any system that may be r carrying out works.

only Europeans required would be men suitave the supervision of the work, with a ficer to organise and direct.

inion is formed from my experience in India years 1866-7-8, when I had chief charge of ction of the railway works between Koolburga ore, about 200 miles north of Mysore.

perations were commenced, not more than forty men could be obtained, and these were ned to the kind of work, but within a year, from eight to nine thousand men were got om various districts, so that no difficulty as need be apprehended.

JOHN ROBINSON, Civil Engineer.

East Grinstead Railway,
ineer's-office, Kingscote, East Grinstead,
Feb. 14th, 1881.

PREVENTION OF FLOODS.

ng the face of the country, one is struck with r, tortuous character of the water-courses streams in many places, also, weed-grown l with gravel. Much good might be effected on every farm if these ditches, water-courses, gulleys, &c., were, as far as possible, straightened; but, at all events, carefully dredged, widened, deepened, and (where necessary) embanked. It would be necessary to resort to dredging at intervals of about four years, even when the work was well done at first; in fact, constant attention would be needed as a consequence of the winter's frost, the spring freshet, and the summer's growth, so as to maintain these arteries in a fit condition to act as water carriers. It may be as well to add that, if this were done, it would be necessary to make arrangements to secure effective irritation, and also a storage of water to provide for seasons of drought.

It may be said that this work would be both arduous and costly. Unquestionably; but, at present, the loss to the country through the desolating waters amounts, in one or the other of the ways I have mentioned, to hundreds of thousands of pounds annually.

The best plan would seem to be, that the farmers of a certain district should associate themselves together, employ such machinery, and such a number of hands, under skilled and experienced management, as would ensure the effectual carrying out of the work.

Doubtless, if this is really to be attempted, the landlords must assist. The farming interest is so heavily weighted, that it cannot pay even a moiety of the cost. The importance of the subject must be my excuse for bringing it, at this time, under the notice of members of our Society.

JAMES O. BEVAN, Assoc. Inst. C.E., &c.

72, Beaufort-road, Edgbaston, Birmingham,
February 19th, 1881.

GENERAL NOTES.

Telephones in India.—The Government Telegraphs Department in Calcutta obtained in November last, a sample supply of some thirty of the loud-speaking telephones of the Gower-Bell Company for experimental trials, and it is reported that the results have given so much satisfaction that the company has now received by telegraph an order for a large number of its instruments. If, says the *Engineer*, this may be taken in conjunction with the recently announced refusal of the Government of India to sanction the setting up of telephonic exchanges on the part of private speculators, it would seem to indicate a resolve on the part of the executive itself to supply the Indian public with what will soon be found to be an indispensable aid to the business and pleasure of life in India.

MEETINGS OF THE SOCIETY.

ADJOURNED MEETING.

Friday evening, at eight o'clock:—

FEBRUARY 25.—Discussion on Mr. Sedley Taylor's paper on "The Participation of Labour in the Profits of Enterprise." W. H. HALL will preside.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock:—

MARCH 2.—"Lighthouse Characteristics." By Sir WILLIAM THOMSON, LL.D., F.R.S. F. J. BRAMWELL, F.R.S., Chairman of Council, will preside.

MARCH 9.—"Ascents of Chimborazo and Cotopaxi, in 1880." By EDWARD WHYMPER.

MARCH 16.—"The Compound Air-Engine." By Col. F. BEAUMONT, R.E.

MARCH 23.—"The Increasing Number of Deaths from Explosions, with an Examination of the Causes." By CORNELIUS WALFORD.

MARCH 30.—"Recent Advances in Electric Lighting." By W. H. PREECE.

FOREIGN AND COLONIAL SECTION.

Tuesday evenings, at eight o'clock:—

MARCH 1.—"The Languages of Africa." By ROBERT N. CUST.

MARCH 15.—"Diamond Fields of South Africa." By R. W. MURRAY.

APRIL 5.—"Trade Relations between Great Britain and her Dependencies." By WILLIAM WESTGARTH.

APPLIED CHEMISTRY AND PHYSICS SECTION.

Thursday evenings, at eight o'clock:—

MARCH 24.—"The Future Development of Electrical Appliances." By Prof. JOHN PERRY.

The meeting previously announced for April 7 will be held on May 12.

INDIAN SECTION.

Friday evenings, at eight o'clock:—

MARCH 4.—"The Results of British Rule in India." By J. M. MACLEAN. Sir DAVID WEDDERBURN, Bart., M.P., F.G.S., will preside.

MARCH 25.—"The Tenure and Cultivation of Land in India." By Sir GEORGE CAMPBELL, K.C.S.I., M.P.

MAY 13.—"Burmah." By General Sir ARTHUR PHAYRE, G.C.M.G., K.C.S.I., C.B.

Members are requested to notice that it may be necessary to make alterations in the dates of the above papers.

CANTOR LECTURES.

Monday evenings, at eight o'clock:—

The Third Course will be on "The Scientific Principles involved in Electric Lighting," by Prof. W. G. ADAMS, F.R.S. Four Lectures.

Syllabus of the Course.

LECTURE I.—MARCH 7.

The production, regulation, and measurement of electric currents.

LECTURE II.—MARCH 14.

The laws of the mutual induction of currents and magnets. Efficiency of magneto- and dynamo-electric machines.

LECTURE III.—MARCH 21.

Use of magneto- and dynamo-electric machines for electric lighting. Heating effects of the current. Electric lighting by means of the arc.

LECTURE IV.—MARCH 28.

Subdivisions of the electric current. Incandescent lamps. Luminous effects of electric currents in a vacuum, and in various gases.

The Fourth Course will be on "The Art of Lace-making," by ALAN S. COLE. Three Lectures.

April 25; May 2, 9.

The Fifth Course will be on "Colour Blindness and its Influence upon Various Industries," by R. BRUDENELL CARTER, F.R.C.S. Three Lectures.

May 16, 23, 30.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 28TH....Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. Sir Richard Temple, "The Lake Region of Sikkim, on the Frontier of Tibet."
British Architects, 9, Conduit-street, W., 8 p.m. Discussion on "The Existing Law of Light and Air."
Institute of Actuaries, The Quadrangle, Ki
W.C., 7 p.m. Mr. G. R. Hardy, "Tl
observed amongst the Various Classes of I
in the British Empire Mutual Assurance (
Medical, 11, Chandos-street, W., 8½ p.m.
London Institution, Finsbury-circus, E.C.,
Justin McCarthy, M.P., "Ireland."

TUESDAY, MACH 1ST...SOCIETY OF ARTS,
Adelphi, W.C., 8 p.m. (Foreign and Colo
Mr. Robert N. Cust, "The Languages of
Royal Institution, Albemarle-street, W.,
E. A. Schäfer, "The Blood." (Lecture
Medical and Chirurgical, 53, Berners-st
street, W., 8½ p.m.
Civil Engineers, 25, Great George-street,
S.W., 8 p.m. 1. Discussion on "The
Limiting Dimensions of Girder Bridges
permitting, 2. Sir William Thomson, "
Tidal Harmonic Analyser, and Tide Predi
Biblical Archæology, 9, Conduit-street,
1. Rev. A. Lowry, "A Few Notices in A
Writings on the Sagacity and Habits of A
Eberhard Schrader, "Abydenus and
Daniel."
Zoological, 11, Hanover-square, W., 8½
F. Moore, "Descriptions of New Genera
of Asiatic Nocturnal Lepidoptera." 2
Westwood, "Observations on Two Spec
Butterflies, *Papilio castor* and *P. pollux*.
Collett, "*Halichærus gryphus* and its Br
Fro Islands, off Trondhjem's Fiord, in N

WEDNESDAY, MARCH 2ND...SOCIETY OF ARTS
Adelphi, W.C., 8 p.m. Sir William Thon
house Characteristics."
Entomological, 11, Chandos-street, W., 7 p.
Pharmaceutical, 17, Bloomsbury-square,
1. Mr. E. M. Holmes, "Vote on Jafer
2. Mr. E. M. Holmes and W. Elborne, "
Drugs from Socotia."
Archæological Association, 32, Sackville-str
Mr. J. Romilly Allen, "The Saxon Cross
Lancashire."
Obstetrical, 53, Berners-street, Oxford-stre

THURSDAY, MARCH 3RD...Royal, Burlington-house,
Antiquaries, Burlington-house, W., 8½ p.m.
Linnean, Burlington-house, W., 8 p.m.
Shattock, "Reparative Processes in Plan
F. Jeffrey Bell, "The Apparent Retent
anal Plate by a Young *Echinometra*."
Clarke, "Arnebia and Macrostomia." 4.
Watson, "Pleurotomidæ of *Challenger* E
Chemical, Burlington-house, W., 8 p.m
Hatton, "The Action of Bacteria on Va
2. Dr. C. M. Tidy, "The Oxidation of O
in Running Water." 3. Dr. F. R. Japp
Wilcock, "The Action of Aldehydes on
quinone in presence of Ammonia." (Se
4. Dr. Japp and Mr. N. H. J. Miller, "
Benzoic Acid on Napthaquinone." (Preli
London Institution, Finsbury-circus, E.C.,
J. G. Wood, "The Inside of an Insect."
South London Photographic (at the H
SOCIETY OF ARTS), 7½ p.m.
Royal Institution, Albemarle-street, W.,
William Houghton, "The Picture Origin
form Characters." (Lecture I.)
Pathological, 53, Berners-street, Oxford-stre
Civil and Mechanical Engineers, 7, Westmin
S.W., 7 p.m. Mr. J. B. Walton, "St
versus Heavy Works"
Archæological Institute, 16, New Burlingt
4 p.m.

FRIDAY, MARCH 4TH...SOCIETY OF ARTS, John-s
W.C., 8 p.m. Mr. J. M. Maclean, "T
British Rule in India."
Royal United Service Institution, Whiteha
Sir William Thomson, "His New Navig
Machine and Depth Gauge."
Royal Institution, Albemarle-street, W.,
William Thomson, "Elasticity viewed
mode of motion."
Geologists' Association, University College
1. Professor T. G. Bonney, "Remark
Classification of Rocks." 2. Professor
"A New Theory of the Formation of B
J. Slade, "Notes on the Microscopic St
Basalt of Swallow Cliff and Uphill."
Philological, University College, W.C., 8
Brandreth, "Grammatical Genders."

SATURDAY, MARCH 5TH...Ladies' Sanitary Associatio
OF THE SOCIETY OF ARTS), 5½ p.m. Dr.
son, "Domestic Sanitation or Health at
ture IV.)
Royal Institution, Albemarle-street, W.,
Stuart Poole, "Ancient Egypt in its Co
tions." (Lecture III.)

L OF THE SOCIETY OF ARTS.

No. 1,476. VOL. XXIX.

FRIDAY, MARCH 4, 1881.

...tions for the Society should be addressed to the Secretary ... John-street, Adelphi, London, W.C.

NOTICES.

...HYMPER'S PAPER ON CHIMBORAZO.

...ordinary meeting, on Wednesday, 9th ...r. Edward Whymper will give an account ...nt ascents of Chimborazo and Cotopaxi. ...to accommodate the large number of ...who have applied for tickets, this ...will be held, by permission of the ...he Committee of Council on Education, ...ture Theatre of the South Kensington ... Admission will be by the West Entrance ...seum in Exhibition-road. It is hoped ...rrangement will be found convenient to ...ers. Though every effort was made, it ...impossible to obtain a room of sufficient ...he Society's House.

...eting will commence at Eight o'clock. ...n at Half-past Seven. About twenty ...ill remain for distribution, and one ...be supplied to Members who apply ...number is exhausted.

...on can be admitted without a Ticket.

By Order,

H. TRUEMAN WOOD,

Secretary.

STREET ACCIDENTS.

...eeting of the Council on Monday, 28th ...an application from the Society for ...Street Accidents was considered, and ...ing gentlemen were appointed a Com-...meet a deputation from the Committee ...ociety, viz.:—Sir Rutherford Alcock, ...r. G. C. T. Bartley, Mr. Andrew Cassels, Sir Henry Cole, K.C.B., Sir Philip Cunliffe-Owen, K.C.M.G., C.B., C.I.E., with the Chairman of the Council (Mr. F. J. Bramwell, F.R.S.). The Committee of the Street Accidents Society appointed to confer with the members of Council are:—Lord Dorchester, Viscount Templetown, the Rev. W. Rogers, Mr. Brown, and Dr. Goodsall.

UNION OF INSTITUTIONS.

The following Institution has been received into the Union since the last announcement:—

North London High School for Boys, Castle-house, Mildmay-grove, N.

APPLIED CHEMISTRY AND PHYSICS SECTION.

Thursday, Feb. 24, 1881; Captain Sir GEORGE NARES, R.N., K.C.B., F.R.S., in the chair. The paper read was "Deep Sea Investigation, and the Apparatus employed in it," by J. J. Buchanan, F.R.S.E., F.R.S. This will be printed in the next number of the *Journal.*

PROCEEDINGS OF THE SOCIETY.

ADJOURNED ORDINARY MEETING.

Friday, February 25th, 1881; W. H. HALL in the chair.

The discussion on Mr. Sedley Taylor's paper on "The Participation of Labour in the Profits of Enterprise," adjourned from the 16th ult., was resumed.

Mr. George Shipton said he should like to refer in a few words to the remarks of the Chairman in reference to English trades unions. He understood him to say that, probably, we had not been able to see our way to such a means of reconciling the interests of employers and employed in this country as had been arrived at on the Continent, in consequence of the hostility of English trade societies. He was sure the Chairman would be the last knowingly to inflict such injustice on English trade societies, and he could assure him that members of the trades societies, instead of being hostile to any conciliatory offer, were always the first to make it. He could say a great deal on the other side, of men who had entered into negotiations and signed contracts that there should be no alteration of time or of wages without three or six months' notice, and he had known employers, in the face of an agreement like that, signed by both sides, scatter the whole thing to the winds without the least notice, and insist on a reduction of wages, and lock the men out if they refused. There was a case of the kind in Bristol at that very moment. However, he had no desire to use words which would increase any bitterness which might exist between employers and employed. They were met for a different purpose, that of endeavouring to recon-

cile the interests of both parties as far as possible. The subject had been somewhat departed from last week in the discussion, which touched on the question of good work and bad work, piece work and day work. This would form a very fitting subject for discussion by itself, but he would prefer pointing out what seemed to him defects in the various schemes brought forward by Mr. Taylor. To begin with, he took exception to one point, which, unless it were got over, would prevent English working men from taking an interest in the scheme, and that was to say that the participation should only take place in the profits to be created by the extra exertions of the men. He certainly thought that if workmen, by their own perseverance, skill, and care, made profits which the employer had not contributed to, those profits rightfully belonged to the men, and surely the employer would not be so immoral as to participate in profits which he had not been instrumental in creating. If the participation were only to come out of new profits, they had to thank the employer for nothing. He held it should be a participation in the general profits derived from the joint energies of those employed in the particular house, or calling. The next best scheme was very much after after the fashion of the plan adopted by Mr. Bord. He should advocate immediate cash payments of profits to workmen, and not a deferred advantage, though possibly there might be no reason why an agreement to defer the payments should not be made. It might be said that if the workmen suddenly enjoyed a degree of prosperity they were not used to, they would squander the money, but he had yet to learn that that did not apply to other classes as well. Why should a special moral restriction be applied to workmen, which was not applied to all classes? The Rev. Mr. Blackley had put forward a national scheme of insurance, which certainly had the merit of compelling all classes to contribute, without exception. What he objected to in Mr. Bord's plan was, that he wrote off 10 per cent. per annum on the capital invested, and then took half the profits remaining, the other half being divided proportionately amongst the workmen who had contributed towards those profits. He thought 10 per cent. was an excessive price to charge as interest upon capital sunk in a business, and that 5 per cent. was the maximum. If they wrote off 5 per cent., he held that all the profits derived from the joint energies of those engaged in the firm should be divided proportionately to their wages, amongst employers and workmen, giving to the employers their extra share as managers, and so on; but if they were going to make themselves so secure, first by having 10 per cent. on the capital, and then taking half the profits, there was very little left for the workmen. It seemed to be the idea that all these things must come from the workmen's side, and nothing from the employers. Otherwise, with this exception, Mr. Bord's plan was the best, inasmuch as there was an immediate payment of profits. The position of Mr. De Courcy was simply an utter piece of selfishness, and he should be sorry to see it applied in English industrial life. The persons employed in his office got no advantage until they had been in the firm 25 years, and then it was not paid to them at all, but invested in the house, or in Government funds, and practically the men received no direct advantage. He was one who did not approve of postponing every advantage from his labour until he was dead and gone; he liked to participate in them while he was alive. Mr. De Courcy's own language showed the scheme to be an utterly selfish one, because he referred particularly to its influence in making the *employés* work long hours in place of fresh hands being engaged. Now, if they only looked at the fact that in England there were a million of paupers to keep, and that one in ten of the population died a criminal or a pauper, it was absurd to put up as solu- ... the labour question a scheme like this. ... rather to shorten the hours of ... that workmen might

come and take part in such discussions as the present. If English workmen were ever to hold their own it must be by lifting up their whole character, not by making them into a degraded and ignorant race. If they had not time, how could they improve themselves, in order that they might stamp on their own work their own character and their own conscience. He should therefore deprecate any system which would tend to physically deteriorate the workman, and shut out those from employment who were as much entitled to it as those who had already a position in the firm. Mr. Ch... plan was too paternal. He would rather see a ... entrusted with his own money, even if he made mistakes at first, because it would lead the way to a better state of things hereafter, and the freedom ... would have would be much more valuable than tra... him up in any way under the guise of pat... Government. English workmen would never be in- duced to go into any scheme of that kind ... payment were deferred. He could give a striking instance of this. About 1878, M... Wingate and Co., ship-builders, at Glasgow, ... in their establishment, an insurance and accident fund, to which the workmen were compelled to ... scribe. This was retained by the firm, and ... posited in the name of the firm. Some time after ... went into liquidation, seized on the money, and ... buted it amongst the creditors as part of the assets ... that the workmen, although it had been deducted from their wages, lost every farthing of it. ... system which would hand over to the employer profits to keep for the workmen would be highl... satisfactory. If the sums were held in trust for ... at all, it should be done by some responsible ... by some one agreed upon by both. As far ... had had time to study the plan of the la... Leclaire, that was the best as a compromise, ... there the workmen's counsels were brough... operation with the employer. The emplo... his proper position as administrator of ... giving to it all the force of his individual cha... at the same time allowing his workpeople to ... in the whole profits. There was only one ... he should like to have cleared up. He b... had to be employed for six months before ... pated in the profits. Now, in times of bris... were many workmen called in for three or ... who contributed to the prosperity of th... could not see why they shoul dbe shut ou... pating, to some reasonable extent, simpl... were unfortunate enough to be employed ... time. No more than 5 per cent. was ... capital invested; the work was done ... working hours, and the extra profit... accumulated by the extra conscience ... developed amongst the men, and nc... excessive number of hours. Th... extend to all workmen, and h... not intended that the system sh... solely through any "nigger-drivin... the workmen were to work th... death in order to live, which wou... physical deterioration. It shoul... work that the profits should be rea... agreed with Mr. Taylor's position ... of his remarks. If there were a... kind, one thing was absolutely n... that the English employers shoul... and arrogance, and no longer re... men in council. At present, th... in their carriages, and knew no... men than the Czar of Russia. ... agents, and managers, but w... never came in contact. Th... vicissitudes of labour and d... present time that had be... but if there were a chang...

glad to carry out such a scheme as that pro-

William Botly could not quite agree with the ; remarks of Mr. Shipton. He rather understood : 10 per cent. would be 5 per cent. on the capital ed in the business, and that the other 5 per cent. be for the maintenance of the manager. As s the importance of dividing a portion of the among the labourers, there should be a con- i of opinion, and he thought, on the general ple of the paper, they would be all agreed. In bk which they all professed to be the rule of lm, they were told not to muzzle the ox that at the corn, and that the labourer was y of his hire. Anyone at all acquainted with cture, agriculture, or commerce, found that it he interest of the employer to do his duty to the an, by giving him a sufficient wage for his day's which should allow him to provide for old age. should all do what they could to encourage and the principle now brought forward would, ght, encourage that, and also the straightforward ness which they all desired to see in the work- a. The paper had given proof of the beneficial of participation in profits in France; and not- ding some difference in the habits of the and English, he did not see why the same should not be adopted here. The remark result of labour, until it was ascertained, unknown quantity, was quite correct; but urer might be paid the regular wages district, and at the end of the year the ould be very easily reckoned. That would ularly applicable to agriculture. There were in England where that was done—as, for on the property of the Speaker of the House ons. No doubt, there would be occasions—as, ice, the year before last, which was the most ate year ever remembered—when there would ofits. One gentleman said the loss to the interest, on wheat alone, was five millions; elieved it would be found the loss would be millions; and, of course, in that year the ral labourer would have had no division of all. He hoped to see the time when, by ucation and more thrift—which every one courage by their own example, whatever their n life—the position of English workmen would ved. No one ever rose to eminence without plication. This was shown in the case of loore, the Morrisons, and others. Some might workmen had not the power of doing so gene- t he said they had. He knew instances of who had raised themselves from common to be small farmers; but then they made bich the generality did not do—they were not or drinkers, but made the most of every trifle.

ainlan said he did not come with the intention ng, but he thought he was bound to meet the remarks which were made by Mr. Shipton ard to employers and workmen. He stated workmen were always anxious for arbitration, ubmit their case for equitable decision, and employers were not so. But look at the present affairs in Lancashire and Yorkshire. In these the colliers have struck for higher wages, which loyers say they cannot give; and they have a proof of this, to lay their books before any it accountant, and to submit the whole dispute ation. According to the papers, that had been He did not wish to say a word against work- he protested against the entire class of em- ed capitalists being stigmatised as tyrannical at because some had been harsh. Mr. Shipton to more than five per cent. being allowed to the employer. But take the case of hazardous busi- nesses, such as collieries, in which he was largely interested, and in one of which he was a director. They were liable to explosions and all sorts of acci- dents. Would any man who had money be satisfied to put it in these hazardous things for five per cent.? It would pay very well in some things. Three per cent. paid in Consols, but 20 per cent. would scarcely be a remunerative return in other occupations, such as mining, where the chances of loss of both capital and interest were very great. Mr. Shipton also stated that the whole of the profits should be divided amongst the workpeople; not that which they made by their own diligence or extra work. But would they divide the losses as well? It was necessary to face this question. They would only give five per cent. interest, and all the additional profits must be divided amongst the men; what about the losses. For various reasons he was in favour of a partial division of profits and superannuation. If a man went into an establishment, such, for instance, as Krupp's Iron Works, and he knew by the rules he would be entitled to superannua- tion by a certain time, it was a check on the natural tendency of a young man to change, and the conse- quence was, men would stop in such an establishment, with the result that they went on all through their lives at good wages, with plenty to eat and drink, and everything a man wanted, whereas, if they got the whole of their profits they would probably become rolling stones and ramble about, some would get to high positions, and others would go to the workhouse. He should prefer the middle course, giving the man a share every year of the extra profits, and putting by an equal amount, which he should be paid in case of accident or death. A case had been mentioned of the money put by being seized by creditors, and he believed something of the same sort took place with regard to a co-operative farm, which was carried on successfully for some time in Ireland, but all this could be guarded against if proper arrangements were made in the first place. Then it was said that new men ought to share with the old, but he could not see the justice of that. It was not the case anywhere, that he knew of, that a new man in an establishment got equal wages with an old one, except, perhaps, in a particular shop, where every man went in on the same footing, under special circumstances. He believed the participation plan was the best which could be adopted; and he thought the reason why some efforts of this kind had failed was, that the difficulties were not sufficiently appreciated and provided against. Some men would not care for the system, others, on the contrary, appre- ciated it. He could understand why Leclaire succeeded, by reading his life. He started as a workman, and gradually built up his establishment, and he could imagine him carefully selecting his men and his fore- men; and when he commenced this participating scheme he was surrounded by a set of men whom he knew, and who knew him. The same principle would answer in this country, and it would help to put an end to piece-work, which, in the interest of all con- cerned, it would be well to get rid of, if possible. He did not see why the plan should not succeed, if it were carried out here with the intelligence which Frenchmen exhibited, but it should not be put in force without preparation. The men should be selected in the first place, and there should be means for getting rid of those whom it did not suit. He had always seen, that if you gave a man an interest in his work it would be done better, and more of it would be done.

Mr. George Howell said Leclaire's system did provide for dividing profits with the very newest comer into the firm, an instance of which was given in Mr. Hall's book or in Mr. Sedley Taylor's article, of a man who had worked one day of ten hours, when he received 6 francs and

50 centimes for his wages, and, at the end of the year, he had his proportion of profits just the same as the rest. He thought they had not yet realised the principles laid down in the paper, the central point being that the men contributed nothing in the shape of capital to the firm, but the whole of the capital was got out of profits. He was now using the term capital in the sense of money, not in the widest sense. The principle seemed to be this, that the men, not by working longer hours, but by working the ordinary day and being paid the current wages in the trade, having a chance of participating in the profit, threw an amount of intelligence, and skill, and energy into their work which had not previously existed. He did not think the workmen had anything at all to complain of in that respect. If they were paid the current wages, they realised that for which unions were primarily started, and if by extra energy and skill they could create more profits than the master originally obtained by the ordinary, perhaps slovenly and wasteful work, they were allowed to participate in those extra profits. That was only the first initiatory stage of the scheme, a stage which, to his mind, could be applied easily to almost the entire ramifications of industrial life in this country, and the workmen surely would have nothing to complain of if, after having been paid their just wages, they realised something in the way of profits, the higher the share, the better, of course; in Leclaire's establishment, it amounted to about 15 per cent. It ended in this—and the moral was the grandest part of it—that these workmen became better workmen than the ordinary workmen in the trade, and were not only paid the ordinary wages of the district, but could command higher wages, and were actually paid higher wages, and, in addition to that, still had the bonus. That was the earlier stage of the matter, but it was the other stages taken up by Leclaire which showed up the moral grandeur of the scheme, and he could not believe Englishmen were so far behind Frenchmen that the same could not be done here. He did not think Englishmen were more selfish than Frenchmen, though they might not be quite so free in their speculations. Leclaire's scheme was worked out under the great disadvantage of not being able to meet in public and discuss their plans, and thus lay down the basis upon which to work. The first starting-point seemed to have been his absolutely bringing in some bags of money and dividing the profits—not upon the year he had promised them, but upon the previous year, because the Government had refused permission to hold a meeting. The scheme which, perhaps, caused the greatest amount of discussion was the greater and broader one, in which the men became absolute co-partners—a scheme which, in a certain sense, had been applied in this country, and was still applied in some instances; but, in this particular case, not only were the men paid their full wages, and participated in a certain proportion of profits, but were entitled to all the benefits of the mutual aid society—in its first stage contributed to by the men and by the masters, but ultimately only contributed to by the profits—and the men participated in the first distribution of its funds when the society was dissolved. Subsequently to that, and in all later stages, the capital seemed absolutely to have been created out of the firm, a proportion of it having been set aside, in addition to the wages and the bonus, until the mutual aid society had sufficient funds, or nearly so (the balance being made up by Leclaire himself), to make it a sleeping partner in the concern. When the employers of England, or a large number of them, could once see their way to say to any number of men in their employment that they were prepared to make a similar step to that, his belief was that the workmen, whether unionist or non-unionist, as a rule would jump at it, but the difficulty was the one hinted at by the last speaker with regard to the losses that might be sustained in the course of business. Those losses were prudently prepared for by Leclaire, as they were by other prudent employers. A man who made 20 [per] cent. this year, as a celebrated firm did which had b[een] referred to in the course of the debate, and divided the profits among the proprietors, and made no [pro]vision by a reserve fund, and then asked the me[n to] help bear the loss when it came, was a very diffe[rent] thing to Leclaire's system. It was not enoug[h to] say whether the firm should reserve to themselves [5 per] cent. or 10 per cent., seeing that the firm made [the] business and found the capital. No doubt 5 per [cent.] certain was beginning to be recognised as much b[etter] than a fluctuating per-centage, ranging from 1[0 per] cent. or 20 per cent to *nil*; and when they [had to] provide against these contingencies, it migh[t be] found that 5 per cent. would be sufficient. [That] was just the amount reserved by Leclair[e as] interest on capital in his business, that [was] given equally to the partners for their [share], and to the mutual aid society for its share, alt[hough] its share of capital was made out of the profits. [The] question was, was there any insuperable difficu[lty on] the part of English working men to entertain prop[osals] of this kind, should they be made by their employ[ers]. He could not conceive for one moment that the[re was] any objection to the scheme being tried anywh[ere, or] that any well organised trade union would rai[se any] objection to it. It was altogether outside the p[rovince] of the unions. He did not mean to say but [that a] well conducted firm of this description might inci[dent]ally interfere with the working of the union, bec[ause] some of the societies had a very well elaborated sch[eme] of mutual aid, in the shape of a sick fund, an out-[of-]work fund, and so on, such as was provided for in [the] mutual aid society of Leclaire, and that migh[t be] interfered with indirectly; but, if it were found [that] this could be done better in some other way, Engl[ish]men would soon agree to the change. But suppose [the] scheme to go on in the most favourable mann[er, it] would be a long time before it would be able to do [so] with great unions, like that of the engineers', wh[ich], perhaps, provided more for the sum paid in than [any] other benefit society. He could see many reasons [why] workmen should seek these advantages if employers [were] only willing to concede them, but it was lamentab[le to] him to find that instead of the bonds of union bet[ween] emyloyers and employed being made closer they [were] being continually loosened. They began that [way]; they went from the month to the week in hiring, [and] from the week to the day, and again from the da[y to] the hour, and the system existed now of mere min[ute] contracts. How was it possible for any indivi[dual] man to have an interest in the welfare and p[ros]perity of a firm when he might be dismissed [at a] minute's notice? Anything which would give [him] a permanent and binding interest in the firm w[ould] help him in future life in more ways than [the] mere fact of getting regular wages, because it w[ould] have a great moral effect. He was, theref[ore], in favour of helping forward this movement as far [as] possible, by discussion and otherwise, until some [em]ployer of labour, having something like the gen[erous] sympathies of Leclaire, would be prepared to try i[t on] a broad basis. With regard to the character of [the] business in which it was tried, he did not think that [the] house-painting and decorating business in Paris [was] quite of the precarious kind that it was in this coun[try], and so far, Leclaire had an advantage; but it mu[st be] recollected that the painting and decorating firm[s of] this country were not limited to those who were c[on]nected with jerry builders and field ranging, as it [was] called. There were great firms in London which [kept] their men on almost permanently, only disch[arging] them under great and continued pressure. If the [scheme] could be tried in that particular trade where a man [had] to take upon himself a certain amount of indep[endent] action, and yet must co-operate with the whole of

produce a good result, it could be done in s. It was tried in this country to a greater in many supposed, especially on the system icularly commented upon by Mr. Shipton ferred profits; but it sometimes became to compel the owner of a share in the profits to go out of the firm, and take his ith him. He did not know whether he was curate, but he had heard, on good authority, a who had been for 24 or 25 years occupy-ood position in a considerable firm, and who ly in life had participated in the profits to a ent, and also allowed a portion of his salary mate. Ultimately, some alterations being h the firm, it was suggested to him that he tire from the business; he was willing to do gh he did not like leaving, but said he should ave his money there. He was told, however, y had as much as they knew what to do with, ough it seemed an incredible sum, he was in-on good authority, that the man was paid no n £50,000 as his share. In Leclaire's establish-per cent., on the average, was divided for nine d in addition to that the men had £21 each out utual aid fund when it was shared. If they on to a second share in that fund, it seemed that, in the course of the next 15 years, they re shared from £50 to £60 each. He could hat he hoped some employers in this country e their way to bind their men to them ing them a participation in profits, and making them co-partners in the firm, ne example of that kind would do a great to advance the matter than any amount of

lley said he had read Mr. Taylor's paper and ion on the previous occasion, although he was t, and he was strongly of opinion that under nditions labour was entitled to much more sent it generally received out of the profits se. He said this as an employer. Taken , capital now stood as an absolute ruler of exercise, a despotism of the most absolute but he was of opinion that such a system be much longer tolerated. These schemes lieved, honest endeavours to find a remedy t for labour more justice, and he should ssist in the proposed society for making the r known. It would be much more difficult, in England than in France, because the re much more suited to co-operation; the ere slow to believe in any idea until it was be an advantage, whilst the French were y any new scheme of equality and frater-th respect to the conditions under which on could and should be attempted, any to try it where the employer did not consider that he had certain moral duties abour, would soon, he feared, end in failure. m read a paper at the last Trades Union in which he dealt with the position of , and pointed out that they ought to regard s as discharging a public function, namely, onservators and administrators of human Unless capitalists recognised these moral d obtained the respect, esteem, and trust of men, he could see nothing but failure. Carlyle ash never yet paid one man fully his deserts to and never would. You might commence on in a concern by appealing to the greed and of the *employés*, and in that way get them to r and amass money, and assist capitalists to se, and this was pretty well as far as Mr. shed the matter to be carried, but in his s was a most objectionable way of gaining a f prosperity, even if that could be *thus* They must appeal *to the great moral power* in man, not to his selfishness and greed. A true workman did not work honestly and thoroughly because he was paid to do it, but because he felt to do the contrary was despicable and dishonest.

Mr. Pfoundes thought they were overlooking the fact that a great deal had already been done in past years in the direction pointed out by the paper in foreign countries. Twenty-four or twenty-five years ago, efforts were made in this direction in the Australian Colonies, and he wished to point out the necessity of turning attention to what our own countrymen had done, when released from the trammels so much complained of, which hampered them at home. There were thousands of the most intelligent of our countrymen living in the colonies and foreign countries, who were actually now competing under most favourable circumstances with those at home, and the time had come when a question like this should be taken up on a broader basis, so that, admirable as the paper was, he submitted it was not altogether what was required. If they could go abroad and see how their own countrymen succeeded there, they might learn some very valuable lessons. The improvement had to come from the men themselves. He had seen Englishmen, landing in Melbourne, laughed and jeered at as new chums by their own countrymen, who had only been two or three years in the colony; and in the same way in Castle Garden, New York, he had seen them laughed at as gawkies, by those who had only been in that country a year or two. He had seen the same class in the New English States, and in the colonies, showing a wonderful improvement in two or three years; and since his recent return to this country, he had seen the necessity of something more than the merely half-hearted measures which were continually suggested, being brought forward. He did not think it was practicable, in a business point of view, to entirely adopt principles which might, more or less, succeed in foreign countries like France; but an entirely reformed social system would be needed; and that reform must come from below as well as above. While there were these conflicts going on between workmen and employers, and they were constantly quarrelling over the shell, other nations were stepping in, and taking the oyster out. Our commerce was falling from our hands, simply from the quarrels of labourers and capitalists. How could they expect a division of the profit which must, in great measure, result from clever, hard-headed men, when they were obliged to go on the market, and speculate in raw material, to keep their hands employed. When he was abroad, some of their own correspondents had sent out goods which were sold at a loss; but they were manufactured simply to keep the mills going. How were profits to be divided in such cases? Would the men stand having a per-centage taken off their paltry wages, in case the head of the firm made a mistake on the market?

The Chairman said there was no intention of taking anything off anyone's wages, the proposal was to add something to them.

Mr. Pfoundes said what he wanted to point out was the necessity of looking to what our countrymen were doing abroad.

Mr. Phillips said his impression was that no system except that of Leclaire was worthy of consideration, because all the others were simply the development of selfishness. They sprang from selfishness in the employer, were calculated to develop selfishness in the workmen, and on the whole, would tend to demoralisation. Leclaire's principle was very simple, and would be *immediately* applicable not to one occupation only, *but* wherever people were employed; the only requisite

was to find the employers with an inborn spirit of justice sufficient to induce them to put it in practice. Once you had the principle, others would soon follow and co-operate. The public, who were much interested in the kind of goods they purchased, could assist by giving such establishments their support. Sometimes there was a confusion made between the capitalist and employer. You sometimes heard rich men called captains of industry, but many of them were not captains of industry at all; they were simply owners of capital, who farmed the industry and intelligence of other men. They took six portions out of ten, and gave the workman only four to live upon, while they grew rich on the six parts they had taken. That was the general rule, and it was supported by the principles of the dismal science. To these men it did not matter whether the wages given to the workmen were sufficient to keep body and soul together or not; if they could get a man willing to accept such wages they felt justified in giving them. But that was not a fair portion. If that system continued to prevail, the labouring people throughout the world who now spoke with one sentiment, but different languages, would eventually have those sentiments conveyed in one language, and when they did so speak, it would be with a solidarity that would have power to act. And how would it act? That lay with the capitalists and employers who regulated the legislation of the country. If they sowed wisely they would reap well, but if they sowed the miserable system which now existed, the time would come when they would reap ill. Various points had been raised which hardly bore on the question. With regard to the interest which should accrue to the invested capital, a statement was made with regard to mines, that the capitalist who invested in a mine suffered from explosion and accidents. He always thought the boot was on the other leg. It was not the capitalist who suffered, but the men. If 15 per cent. was a fair per cent. for the capitalist to receive who invested his money, what was a fair percentage for the man who invested his life? Much stress had been laid on the participation of profits *versus* participation of loss, but he believed the workman was just as fair and intelligent as the capitalist, and if you gave the workman a fair share of the profits, he would be quite willing to take his fair share of the loss. He would not deal with many of the side issues which had been raised, but with regard to piece-work and waste of material, he might say that he had frequently had charge of work, and while in that position had an opportunity of seeing how it was done, and how material was used. He had seldom cause to find fault with men working day-work, but he had noticed the greatest waste of material he had ever come across had been indulged in by piece-workers. You might get the most physical exertion out of a man who worked piece-work, but you would not get the best work. If he (Mr. Phillips) was going to sea, and had the choice of going in a ship which was built by piece-work, or one that was built by day-work, he would much prefer the latter.

Mr. Hodgson Pratt said he hoped that, if any practical result were to follow this discussion, the form participation would take would not be that of giving a few small sums in the shape of bonus at the end of the year, which would be a very small step in the desired direction, but that the main object steadily kept in view would be the permanent identification of interest between the workmen and employers in the same house. That would not be realised by simply giving a bonus at the end of six or 12 months. The great object should be to make the workmen gradually more and more partners in every concern in which they were employed. What was wanted was to do away with the sharp line of division between the two classes, and to make every workman a capitalist as well as a mere wage-receiver. It was quite clear, from the experiments of Leclaire and others, that not only increased industry and desire to prevent waste would be the that, in every form, the identification of i the part of all employed must bring to th ideas and suggestions as regards processes, a which could not fail to be beneficial. It had b out over and over again that many of our ind in a very precarious position at the presen that, in many departments, we were beaten competition. All this tended to show that E now undergoing a considerable crisis, an future depended on her undergoing an indust which should enlist a greater amount of int her manufactures. Compare the present o things, in which the workman could have l interest in the firm, with that which would t every workman in every large firm had an opp being an holder of its capital. In that case intelligence would be constantly thinking how the profits, and make the concern more suc vast number of minds all over the countr electrified, so to speak, by that desire, and th would be forthcoming, which were absolutel to enable us to compete successfully with othe One word with regard to Messrs. Briggs' which had been alluded to. All the facts with that went to show that there was a fat the part of those employers. They did not a workman as an associate, but simply as a w receive what they chose to give him, and w state of things there could never be that con fidence on both sides which was essential the welfare of the undertaking. Tha Briggs could have supposed for a momen workmen in their employ would conse themselves off from their trade associatio in the most striking manner, how comple was the spirit in which they approached the e There must be perfect equality of rights between the two parties. Messrs. Briggs sh selves wholly unable to understand the pro them, when they ventured to trench on t independence and self-respect of their w dictating to them what they should do in with their trade society. If employers movement to succeed, they must approach t an altogether different spirit; treat their wo confidence and respect, and make them sha capital.

Mr. Sedley Taylor said he would reply ver the main objections which had been advan the principle of participation during the Mr. Wolstencroft had expressed an opinion t industries, piece-work would be found supe ticipation. There were, however, theoretical tions of much force which made for the against the former, system. Participation excellence of work in every direction piece-work, though it increased quantit duction in a given time, had no tendenc to improve quality or enhance economy degree which would just pass muster with t ing examiner. But theoretical consideratio all they had to judge by. They had the the important firm, Billon et Isaac, at Gen the managing director and a large majority o men had stated, as their deliberate opinion, work was no effective substitute for parti profits. The two systems were, however, being worked together without the slighte as was, in fact, done in the establishment j to, and in many other participating houses o tinent. The same speaker had denied the a of participation to coal-mining, on the g the colliers were paid only for the coal actua to the surface in proper condition. He (Mr. T

, been informed, during a recent visit to the
le coal-field, that a great preventible waste of
ls occurred in that industry, which payment by
lid not diminish in the slightest degree, but which
ation would directly tend to check. He had
. that large quantities of the timber used for
; up the workings were constantly getting buried
the *débris* thrown out in the hewing process, and
ently lost. The pitmen had no interest in pre-
g this waste, and, rather than make their
yers a present of the labour required to remove
aber to a position of safety, rarely hesitated to
it, for good and all, under the unsaleable small
own aside in the operation of hewing. Payment
s thus actually tended to encourage this waste,
participation in profits would teach the miners
ress it as directly injurious to themselves.
ence to the very satisfactory statement which
made by Mr. Lloyd Jones that there was no
to apprehend hostility on the part of trades union
against a movement for industrial participation,
important letter had reached him (Mr. Taylor)
Mr. Burt, M.P. for Morpeth, whose connection
he miners' union was well known. "I am glad"
Mr. Burt, "that you are carrying on your efforts
r of co-partnership, or, as you well express it,
ation by the labourer in the profits. I quite
ith your views, and wish you every success." A
nt which had the support of Mr. Burt in the
nd of Mr. Lloyd Jones and Mr. Howell in the
ad no reason to anticipate an excommunication
unions. Mr. Trewby had objected to Leclaire's
at it afforded no outlet for individual enter-
, if a man started in business on his own
he would lose whatever he had deposited in
ern. As far as promotion to higher em-
in the house itself was concerned, the
Leclaire offered to unendowed talent and
nce most exceptional "outlets." The posts of
and even those of the two managing partners,
n to, and obtainable solely by, merit. MM.
and Marquot, the present heads of the house,
begun work as simple apprentices, and owed
ent honourable and lucrative positions exclu-
their own abilities and high principle. In
mployment by the house for a private enter-
member of the mutual aid society would
lose his right to a retiring pension, but he
rry with him the result of cash payments,
; 15 per cent. on each year of his work for the
hich it would be his own fault if he had not
cally capitalised. Mr. Trewby's objection
oubtedly, of much greater force against M. de
system of long-deferred participation; it
owever, be borne in mind that that system
ew the case, not of workmen, but of clerks,
d only under very exceptional circumstances
become employers of labour themselves, and
abition was, as a rule, limited to the attain-
confidential posts immediately below those
by the capitalists at the head of the concern.
thus situated, a permanent connexion with one
ame house was a distinct advantage, and the tie
in M. de Courcy's system would, therefore, be
keenly felt by them than by workmen whose
nces involved frequent changes of employer.
hipton's view, that the entire surplus profits
allotted to the workmen whose more effective
led them into existence, he would reply that
erial advantage must be offered to the em-
a return for the time and trouble which he
ve to expend in organising and superintend-
industrial relations. Much thought and
ould be required in making the change and
its success, and employers could not fairly be
n to make such efforts, unless on behalf of a
f mutual advantage. Mr. Shipton's pro-
posal to limit the interest on capital invested in production to 5 per cent., without making any allowance for the great differences of trade risk inherent in different industries, could not possibly be entertained. The same speaker's apprehensions that participation would lead to "nigger driving," and premature exhaustion of the labourer by an increase in the hours of daily work, lacked all support from the experience of participating houses, where the hours were no longer, nor the work more physically exhausting, than in concerns carried on in the ordinary way. It was by united and heartier work, not by intensified physical exertion, that the happy results of participation were to be achieved. In order to show, on the authority of a well-known political economist, that participation in profits approached the problem of capital and labour from the only point of view which offered any prospect of a solution, he would quote the following passage from Mr. Fawcett's work on "Pauperism"*:—"It is vain to expect any marked improvement in the general economic condition of the country, as long as the production of wealth involves a keen conflict of opposing pecuniary interests. The force which ten men can exert may be completely neutralised, if they are so arranged as to contend against, instead of assisting, each other. Similarly, the efficiency of capital and labour must be most seriously impaired, when, instead of representing two agents assisting each other to secure a common object, they spend a considerable portion of their strength in an internecine contest. All experience shows that there can be no hope of introducing more harmonious relations, unless employers and employed are both made to feel that they have an immediate and direct interest in the success of the work in which they are engaged." He was personally authorised to say that the Postmaster-General was prepared to repeat, with even accentuated emphasis, the strongly favourable opinion on industrial participation expressed in the volume just referred to. Mr. Taylor concluded by again urging the advisability of forming a society to promote the practical study of participation, and by renewing his request that conditional adhesions to such a society might be forwarded to him at Trinity College, Cambridge.

The Chairman said he must add one word of explanation of the remark which fell from him on the opening night with regard to trades unions. He merely threw out the suggestion that trades unions might be one of the possible obstacles to the spread of this scheme. He did not make any assertion on the subject, but he was aware that unions did not exist in France, where these participation schemes flourished. He was still bound to think to a certain extent that the trades union organisation, on the part of the men or of the masters, did present certain obstacles to that familiar intercourse between individual master and man which was so desirable, but he could hardly regret having thrown out the remark, because it had elicited such emphatic repudiation of antagonism to the principle of participation on the part of leading unionists. He could not believe that in England—where capitalists were known to bestow £100,000 on founding a library or giving a park to the people, as some men did in the North of England, thus devoting almost the whole of their accumulation in gifts to the place where their wealth was made—that men actuated by the spirit of Leclaire would not be forthcoming. He thought that when such an experiment were set before them, men of the stamp of Hugh Mason and Firth would feel infinitely more satisfaction in spreading their munificence over their whole lives, than in deferring it to the end, and then pouring it forth in this generous and wholesale fashion. In conclusion, he proposed a vote

* London: Macmillan. 1871. P. 184.

of thanks to Mr. Sedley Taylor, and endorsed his desire for the foundation of a society to disseminate information on the subject of participation in profits. At these discussions there had been a more marked attendance of gentlemen representing the working class than the employers, and in order to carry on the subject, he hoped that at the next meeting they might secure the attendance of several large employers of labour.

Mr. George Shipton seconded the vote of thanks.

Mr. Crace, jun., said, as an employer, he begged to add his voice to the vote of thanks, as he felt very much indebted to Mr. Taylor for bringing the subject forward.

The vote of thanks was carried unanimously.

FOREIGN AND COLONIAL SECTION.

Tuesday, March 1st, 1881; Sir HENRY BARKLY, K.C.B., F.R.S., in the chair.

The paper read was on—

THE LANGUAGES OF AFRICA.

By Robert N. Cust,

Honorary Secretary to the Royal Asiatic Society.

It may be asked why the subject of language is brought forward in a Society whose primary object is the illustration or advancement of Arts, Manufactures, and Commerce. The reply is, that language has a very intimate connection with the development of these agencies, and the disclosures made in the course of the study of a language, throw a light upon the social and intellectual characteristics of the people who use it. Language is indeed a Science, but the method of conveying sounds to writing by symbols is an Art, and one of the most ancient, continuous, and interesting. The presence or absence of certain words in a language have a historical value. How shall we account for the Monbutto, on the River Welle, using the word "tobboo" for tobacco? After all, the commerce of thought is the greatest and oldest form of commerce that the world can have known, and no manufacture is older or more widespread, or more ingenious, or representing more clearly the line betwixt man and the lower order of creation than the manufacture of words, which has been going on without cessation ever since the world began.

I do not presume to claim a personal knowledge of any one of the hundred languages of Africa which pass under review, except Arabic, which is an imported alien. My statements rest not upon individual speculations, but upon the practical collection of facts by one class of scholars in the field, classified and arranged by one or two great comparative philologists in the cabinet, and thus presented to the notice of anyone who has the taste to study the subject. Every statement must rest "upon authority," and it is always better to give at once the name of the authority. I have followed not blindly, but with deference, one of the greatest living comparative linguists, Dr. Frederick Müller, of Vienna, who has given us his views in three famous works, "Reise der Novâra," "Ethnologie Algemeine," and "Grundriss der Sprachwissenchaft," only a portion of which last has as yet appeared. In these volumes, the whole of Africa is embraced, and a provisional classification suggested, but certain portions of the field are occupied by three other distinguished German scholars, the late Dr. Bleek, in South Africa; Dr. Koell West Africa; and Professor Lepsius, in N East Africa, and a great diversity of opini found to exist upon many points. Scor learned English, French, German, and Ame scholars have handled different portions o subject, and contributed good, sound bricks t great edifice. Some attempts has been ma popularise this knowledge in England, by Stanford, in his "Compendium of Geograph Travel," and by Hovelacque, in his "Lin tique," but in both volumes all that is reliabl been derived from Dr. Frederick Müller, in th case acknowledged; in the other, this ack ledgment has been forgotten, and conseq the value of the communication is much dimin

It is as well to state in advance, that our ledge is still most imperfect. It cannot be with regard to any of the sub-divisions of th ject, that we have, at our disposal, the m available for forming a definite opinion. traveller has brought home the names o tribes, speaking separate languages. In cases a scanty vocabulary represents all th know of the words, and a doubtful in a map is all that we know of habitat. Now, the two elementary requi for linguistic knowledge of the lowest o are a language-map, showing distinctly habitat of the people, and a vocabulary of extent, showing distinctly the words which use, taken down on the spot, or from the lip individuals to whom the language is their proper tongue in habitual and actual use. have very much the same knowledge of languages of Africa, that a geologist has of the face of the globe, *i.e.*, a tolerably accurate acqu ance with the languages spoken on the coas round the Continent, with an occasional peep the interior, and a visionary speculation on subject of the centre.

The ancient nations of Europe and Asia left records of their languages, as spoken in times, in literature or monumental inscripti With the exception of Egypt, Abyssinia, the P of Carthage, and the Tamâseq of Libya, Africa no record of the past. The seed-plot of all existing alphabets of the world is found in hieroglyphics of Egypt, but no native of A has devised a practical form of writing: syllabary of the Vei on the West Coast merely an ingenious adaptation of an old to new symbols, and not an original in tion. In considering the languages of Af we have no means of comparing the past with present; our task is limited to recording we find spoken by the people, and to redu this record to such a form of classification possible. A century hence some form or oth the Roman alphabet will be the written char of nearly the whole of Africa, being adopte the missionaries and European settlers, east, and south. The Arabic character will be ret for Arabic, and such of the vernaculars as are by half-bred Mahometans; the Abyssinian Libyan form of script, even if they survive in own localities, will never be propagated beyo

I accept the classification of Frederick Mül the best that is possible to devise in the p state of our knowledge; it admits of unlimit

rds the Bántu family; it is exhaustive Semitic and Hottentot; and approxi- regards the Hamitic. The Nuba- b-division, still most imperfectly nd the Negro sub-division is merely h unclassified languages are roughly hing analogous to the Turanian and f the linguistic scholars of a quarter go, without any pretence to mutual connection. Over and above the l by travellers or word-collectors, is de (which no man can as yet number) tongues, which it must be left to ions to discover and record; and, till es place, no one can presume to say it of the languages is complete. And rther complication, that writers con- the fact, that such and such a ying out, and, as this process has n for centuries, leaving not the s on the sands of time, an idea may w remote is the solution of the origin of human speech.

impossible in the brief time allotted more than give a most summary e different groups and languages, I go on, the approximate localities r are spoken. The opportunities have been most exceptional. The ndists of linguistic knowledge all rica, America, and Australia, have st Protestant Missionary Societies, mong them the British and Foreign The motives of the linguistic last society is a higher one than the cience, but it has, by its co-opera- other societies, brought together a nguages and dialects in the form of the Scriptures, the like of which er saw, and which is the wonder of s; and this remark specially applies o other motive is conceivable to scholarship and industry to run the and death for the purpose of reduc- the form of speech of downright t for the one purpose of religious n many languages the Scriptures are k, and a linguistic scholar would l feelings of gratitude, if he did not the missionary for opening out to of information, hopelessly concealed, Society for scattering it broadcast st of the mere printing.

ges of Africa are provisionally the following sub-divisions. I use mily" where a distinct linguistic admitted; in other cases, the word

Semitic.
Hamitic.
Nuba-Fulah.
Negro (proper).
Bántu.
Hottentot and Bushman.

nsider each separately.

tic family (for it is a family in the of the word) is well known. It Indo-European in being inflexive, of inflexion is quite peculiar; it is most beautiful and symmetrical, but no explana- tion has ever been given of its origin. We find it in full development in its earliest records. The Book of Genesis gives an account of the creation of the world, but the words used for that account indicate a language in a very high state of development, and this characteristic is sharply brought out by contrasting the refined mechanism of the speech used by Moses with contemporary Egyptian records. The influence of the Semitic on the Hamitic group, or *vice versâ*, as some assert, is of the slightest. The Semitic nation were at all times alien in Africa, but it received from Egypt the precious gift of alphabetic writing, which it handed on to the rest of the world, as if it were of its own proper invention. There are two branches of the Semitic family, that of the North Coast of Africa, and of Abyssinia.

The Semites possessed the eastern flank of the Nile valley from a remote period. The notorious subjugation of Egypt by the Hyksos, and the descent of the Hebrews into Egypt, have left no linguistic traces in Africa; but the colonisation of Carthage from Phœnicia has left its indelible trace in monumental inscriptions, in spite of the attempt of the Romans to destroy all trace of the foreign culture of their defeated rival. Centuries later, the Arabians conquered the whole northern coast of Africa, beyond even the pillars of Hercules, and Arabic supplanted the old Egyptian language in the Nile valley, and pushing aside, if not destroy- ing, the Hamitic languages of Numidia and Mauretania, became the dominant languages of Tripoli, Tunis, Algeria, and Morocco, with a distinct dialectic variation from the pure form of the Arabian desert, and the Korán. A third Semitic invasion of Africa took place from South Arabia across the Red Sea, and is known as the Ethiopian or Geez, the language of Abyssinia. In course of time the ancient form of speech gave way to the modern Tigre, and the cognate Amháric. These are spoken by a Christian population in a retrograde state of culture. Travellers have brought to notice two other distinct Semitic languages, the Harári and Saho, on the flanks of Abyssinia, but of no importance.

The influence of the Arabic extends far beyond the limits of the settled populations of particular kingdoms. It is the vehicle of thought over the greater part of Africa, either in the mouths of the Bedouin Nomads, who surprise the travellers by their unexpected appearance, or of invading conquerors, such as the Sultan of Zanzibar; of enterprising merchants, such as the slave dealers, who are generally half-bred Arabs; of dominant races, such as that of Waday, in Central Africa; and lastly, it is the instrument of the spread of Mahometanism, and of whatever culture existed independent of European contact. Up to this time it has had entirely its own way, both as a religious and secular power, but it may be presumed, that its progress will now be checked by the powerful intrusion of the English, French, and Dutch lan- guages, and the resuscitation and culture of the numerous, strong vernaculars, which are ready to the hand of the European civiliser and instructor. The Arabs have left names in their language, Kabail, Kafir, and Swahéli, which can never be forgotten.

II. The Hamitic languages come next in order;

they are presumed to be aliens from Asia, but at so remote a period, that the tradition fails. It may be bold in the present state of our knowledge to call this sub-division a family, it will be safer to style it a "group." with marked resemblances. It may be sub-divided into three sub-groups—(1) Egyptian; (2) Libyan; (3) Ethiopian. They probably have linguistic relations to each other, but they have not as yet been worked out, so as to win universal concurrence, in the sense that the inter-relation of the Semitic language is admitted, as a fact of science. All the languages of the first sub-group have passed away from the lips of men; the Coptic died some centuries ago, and has a galvanised existence as the vehicle of religious ritual; the Egyptian died before the Christian era, and as the tradition of its interpretation died also, it became linguistically extinct, or unintelligible, until revived by the genius of scholars of this century. As records carved on stone exist in this language, fully developed both as to its grammar and triple mode of writing, as far back as 4,000 years before the Christian era, no nation in the world, and no family of languages, can compete with Egypt and the Egyptian on the score of antiquity. Moreover, in the handling of words and grouping of sentences, we become aware that we are dealing with an instrument of thought indefinitely more ancient than the most ancient of Semitic or Arian records. Egyptian had its day, and under Greco-Christian influences passed into Coptic, which again disappeared before the inroad of Arabic, thus supplying one of the most notable instances of a nation changing its language, as few will doubt, that the Fellah of Egypt is the lineal descendant of the Egyptians as depicted in the monuments.

To the west of Egypt, along the coast of the Mediterranean, stretches that vast country known to the ancients as Libya. Herodotus, the father of history, knew about the Libyan tribes, as Greek and Phœnician colonies were settled on the coast. This region was known to the Romans as Mauretania Numidia, and Getulia. The Aborigines outlived the Phœnicians, Greek, Romans, and Vandals, and still struggle against the Arabs, Turks, and French. The old Libyan language had no literature; it is dead, and is only faintly guessed at by inscriptions. The region is now known as Tripoli, Tunis, Algeria, Morocco, and the great Sahára. In one sense, the name "Berber" may include all the Hamitic forms of speech of this sub-group, but other terms are met with, either dialects, or separate languages, Kabyle in Algeria, Shilwa in Morocco, Tamáseq in the Oasis of the Sahára, Zanàga on the frontier of Senegal. The extinct language of the Canary Islands, the Guancho, belonged to this group. The French have contributed a great deal to the knowledge of this branch of the Hamitic group, in which there is an entire absence of culture, and the majority of the population is nomadic and savage.

The Ethiopian sub-group of the Hamitic group lies along the Red Sea, intermixed geographically with the Abyssinian branch of the Semitic family already described. The languages are:—The Somáli, Galla, Beja or Bishári, Fulásha, Dankáli, and Agau. The Victoria Nyanza occupies a remarkable ethnical and linguistic position. It is here that the Bántu, Negro, Nuba-Fulah, and Hamitic groups impinge on each other. Mtesa, King of Uganda, is credited with being ‹ origin, ruling over Bántu subjects. Our ledge of the tribes to the north of Victoria is too imperfect to arrive at any certain sions. No Semitic influences have been felt in the culture, religion, or language ‹ races. They are entirely uncivilised, culture, generally pagan, nomadic, and sa‹

III. We pass to the third group, the Fulah, the least well-known, and the most ful classification. Up to this time we ha‹ with inflexive languages; all that rem Africa is agglutinative. Ethnologically sp the Semitic, Hamitic, and Nuba-Fulah b‹ "lank curly-haired" races. All that ren Africa consists of "woolly-fleecy, or wooll‹ haired" races. It does not follow th linguistic fissures should be the same as the and we know that the contrary often p Frederick Müller lays it down that this whose habitat is partly in the midst of th‹ group, and partly on their northern fro‹ distinctly separate from the Negro, both by‹ appearance, and other certain ethnical det occupies a position midway betwixt the ‹ and Negro; and here let it be borne i‹ that the Bántu family is supposed to occ same intermediate position; but the Bánt in their physical and physiological charact take after their Negro pregenitors, while th‹ Fulah approximate more to the Hamiti‹ connection between the Nuba and Fulal by no means certain. Let us consid‹ separately.

The Fulah family is found on the West The word means "yellow." The Fulah c himself greatly superior to the Negro, an‹ a place among "white men." He is foun intermixed with the Negro from the Senegal in the west, Darfúr in the east, a Timbuktu and Haussa in the west to Y‹ the south. He first made his appearan plundering intruder, and he is a Mahomet the kingdoms of Sokotu and Gandu th‹ Fulah power. The name appears as Pu Fulah, Fulbe, Fellata, Fuladu. The Fu‹ has intermixed with the Negro, which h duced other varieties. Fortunately, we excellent grammar by Reichardt, and a tion of some chapters of the Bible by Baikie. Seven varieties of languages, or (for it is impossible to say which) are re but Futa jallo, on the River Senegal, is ‹ as the standard. Its linguistic features use of affixes, and the existence of rational and irrational. The languages accepted as belonging to one family, and ‹ back to the same mother-speech.

The Nuba sub-group reach from the fie‹ Fulah family eastward, to the field of t‹ opian sub-group of the Hamitic group. ‹ Nubians now inhabit the valley of the N‹ the first to the second cataract. They ca selves Barabra, and are Mahometan. ‹ furth's narrative shows that they are a d race, superior in power and culture to t‹ Pagan races of their group, into whose they make inroads as merchants and slave-‹ It is remarkable that the Nubians must ha‹ into their present habitat in historical ‹

us does not mention them, and could not erlooked them, had they been there. The ουβαι first appears in Eratosthenes, who n the latter half of the third century B.C., as a great people, not subject to the ians of Meroe; they must have in the l immigrated from the West. We read of amigrations of the same race in the time of ian, 300 A.D. The name of other languages, lects, closely connected with Nubian, are these races are wholly without culture and are, and imperfectly known, and dwell in the valley. With far less certainty the ... on the river Takázi and Atbara, known by the reports of the Roman Catholic priest, ... and the Wakuavi and Masai, who are known to us by the Protestant missionaries mbása, are included in the Nuba sub- Still more hazardous, and dependent the collection of future material, is the ment to this sub-group of the numerous whose existence has been revealed to us by nfurth and Junker, on the watershed of the f the Nile and the Welle. Unfortunately a royed all Schweinfurth's linguistic collec- They are the Monbuttu, the Nyam-nyam, , and the Golo. It must be left to the eration to decide with certainty concern- anguage of these tribes. Before leaving p of Nuba-Fulah, it may be mentioned classed ethnologically with the Dravidian rian families of India.

e Negro group is the next. As stated s a mere bag, into which all the languages y woolly, fleecy-haired races have been s far as we know, they are all aggluti- it that is but a slight link of connection; o group by no means extends all over ut it comprises the great bulk of the n. A race with less inherent vitality ve been extinguished by the trials which l to undergo, circumscribed to the south of the Bántu, pressed upon to the north uba-Fulah, and deported in millions by peans. The Negro may be said to share Bushman the honour of being the nhabitant of Africa. The tract from the iegal to the River Niger is the seat of the ro, but the return from America, or from vessels, of freed Negroes of very mixed affected this purity, and some of the ices, containing Hamitic, Semitic, and nents, are the finest.

hing about the languages of this group ccepted as provisional. We know neither t of the variety of the languages, their re- each other, or their dialectical variations, we full information regarding those , of which we have vocabularies or cal notes. We can hardly define the s of the field of languages, and they lutely no literature. One thing is clear, cannot have been derived from one igh all, that are known, are agglutinative re. There must have been many distinct for not only does the grammatical forbid the hypothesis of any original there is no such uniformity of voca- would support the idea.

gion extends right across Africa in its broadest extent, from the West Coast to the Nile Valley, where, as stated above, the four groups meet, somewhere in the 4th or 5th degree of north latitude. Three great Negro tracts may be roughly hewn out:—1. The Western Coast; 2. The basin of the Chad; 3. The Upper Nile. The vast empty spaces on the map, both above and below the great Negro belt, warn us of the presence of a great *terra incognita*, and unrevealed millions.

This thought ought to make linguistic inquiriers and speculators into the origin of the human race and language silent and humble. We gather from the pages of Dr. Moffat, that new langnages were coming into existence under his eyes; and from the pages of Dr. Koelle, that old languages were dying out. Schweinfurth, Livingstone. Stanley, Nachtigall, Rohlf, and every explorer, bring back specimens of new vocabularies, or vague indications of new languages, not understood by their African followers. Even the vast collections in Dr. Koelle's monumental work, "Polyglotta Africana," resemble a handful of shells picked up from the sea-shore at random, and useless, until they pass under the hands of the skilful assorter, and some of them not of much use even then.

In this group we have many noble grammars, the work of great scholars; we have numerous translations of the Holy Scriptures, and plenty of religious and educational books; we have grammatical notices of the greatest value, by Frederick Müller, of thirteen of these languages in his "Grundriss der Sprachwissenchaft," and in his "Algemeine Ethnologie" we have the best classification of the group, that the materials available allow him to make. We find twenty-four sub-groups, to which I add another, for the dwarfs or pigmies. Of these, eleven sub-groups represent single and isolated languages, which admit of no relation to any other known variety. This by itself suggests, that the linguistic phenomena of the region have not yet been exposed to view. We do not find isolated languages, except in rare cases, elsewhere, and they generally are survivals of extinct families. The remaining fourteen sub-groups comprise a list of names, some of which are well known as the vernacular of great populations, such as the Susu, Vei, Temne, Yoruba, and Nupe, ahd others can, with difficulty, be traced in the pages of some traveller. Moreover, over and above these, there are other names to be gleaned from the journals of later travellers and missionaries. On the West Coast, the best known sub-groups are the Mandingo, Fulup, Temne-Bullom, Wolof, Bornu, Kru, Ewe, and Ibo. In these linguistic categories will come the French colonies on the Senegal, Sierra Leone, Sherborough Island, Liberia, the Grain Coast, Ivory Coast, Gold Coast, and Slave Coast, the kingdoms of Dahomê and Ashanti, and Bornu, Lagos, the Yoruba country, the basin of the Niger, as far as we know it right and left. In the Chad Basin, comes a sub-group of languages very faintly known. In the basin of the Nile and its great tributary, the Bahr al Ghazal, we find the languages of tribes of Bari, Dinka, Nuer, Shilluk, alluded to by a succession of travellers, and some of whom press upon the Hamitic, Nuba-Fulah, and Bantu groups, near the source of the Nile. Of the additional Pigmy group, we have some notices with regard to the Akka. As an interesting linguistic phenomena, it

is recorded, by more than one observer, that the peculiar liguistic feature known as "the click," generally connected with the Bushman, Hottentot, and the Káfir sub-branch of the Bantu family, exists in the speech of the races of the Upper Nile. This, coupled with the ethnical feature of the smallness of stature of some tribes, seem to indicate the existence of some aboriginal inhabitants antecedent to the present occupants.

We must recollect that the Negro type is a very marked one, and appears distinctly on the monuments of old Egypt 5,000 years ago, and though it may have undergone much admixture in the interior, it is pure on the coast. Of the purity of the languages, we cannot speak with certainty. The presence of the Nuba-Fulah from the north, the presence of the Mahometan religion in their midst, the influence of European nations and Americanised Negroes on the coast, must leave an influence. The Haussa is the great commercial language of Central Africa, far exceeding the limits of the region occupied by the Haussa race. It is an isolated language, and has borrowed from contact with Hamitic and Semitic races certain characteristics. It is spoken even as far north as Tripoli. It is attributed by one scholar to the Hamitic group, by another to the Nuba-Fulah, by a third to the Negro group. It might have been presumed, that there was a general consensus that these Negro languages were independent of any other group of languages; but so great a scholar as Bleek has laid it down, that some of the Negro languages actually belonged to the same family as the Bântu, and others were related to them. This shows how far we are at present from any certainty on any portion of the subject, from the absence of sufficient material.

V. The Bàntu Family. The veteran, Dr. Krapf, claims the merit of the great discovery, that a single family of languages prevailed throughout Africa, south of the Equator, with certain reserved tracts for the Hottentot and Bushman. It was indeed a great discovery, announced by him in 1845, under the name of the Zinjian, a thoroughly unsuitable name, or Nilotic, a thoroughly inapplicable name. The name Bàntu, or "men" is now accepted. In spite of the wide spread of this family from shore to shore, there is unmistakable evidence in their genius, their phonetics, and their vocabulary, that all the languages had a common mother: they can be dealt with in the same manner as we deal with the Arian, Dravidian, and Semitic families. Some of the features of the common parent appear in each of the descendents. The language of the Ama Xosa, commonly called Káfir, is allowed, for the present, to occupy the first rank. However, we must remember that the linguistic and ethnical strata are not always uniform. Some tribes in Lower Guinea speak a Bântu language, through belonging ethnologically to a pure negro type.

The language-field of this family exceeds that of any other, but it would be unsafe to state any, even approximate, idea of the population. New tribes are being made known to us every year. It is entirely independent of any other type of language, having remarkable features of its own. It has been well studied by excellent scholars, both in detail, in separate languages, and as a *family*, by great comparative linguists, such as Bleek and Frederick Müller. It is distinctly ag-
tinative in method, but also alliteral, and su
to remarkable euphonic laws. It has or
frontier been influenced by alien neighbour
we find in some languages clicks, borrowed
the Bushman; and on the north-eastern fr
Hamitic influences are felt in conterminous
guages. However, so little is known for ce
that the development of this marvellous family
be left to the next generation. Frederick M
confidently indicates Semitic and Hamitic
fluences, which must date back to the inf
of the language.

Dr. Bleek, who had actual knowledge of
subject, in addition to a profound knowled
language generally, records his opinion o
characteristics of the family. The words are
syllabic, and the syllables open: diphthongs re
derivative prefixes there were originally si
but only two have a decided reference t
tinction observed in nature, being restric
nouns respecting reasonable beings, the
the singular, the other in the plural n
The form of this latter is *ba*, actually or in
other manner obtained from it. There ar
adjectives, and in their place, most general
participial construction is used. The genitiv
devoted by a prefixed genitive particle. The c
are indicated by prepositions; different kinds
verbs are formed by variation of the ending
moods, and the perfect time are indicated in
same way. The most simple form of the ver
the singular of the imperative.

Dr. Bleek paid also much attention to
euphonic laws, which differentiated one language
branch of language, of this family from the ot
He showed that the languages differed from e
other, more than the language of the Teutonic
Neo-Latin family differ from each other.
greater bulk of words in each language, thou
identical in origin, became wholly dissimilar, ow
to the action of the euphonic laws which cha
their form. The grammatical forms are also v
different. And this difference is to such an ext
that the Ama Xosa and Bechuàna cannot und
stand eacn other, though in the same branch
the family. Dr Bleek took pains to illustrate
new form of what he calls the great "Grim
law of transmutation of sound in Bántu. Th
are three clicks in the language of the Kafirl
sub-branch.

Some further explanation seems required of
euphonic or alliteral concord, which is so strik
a feature; the initial element of the noun, a lett
or letters, or a syllable appears as the ini
element of the adjective; the pronoun assum
the form corresponding to the initial of the no
for which it stands; the important part of
initial of the governing noun is detached to
in forming the bond of connection with,
control over, the noun or pronoun governed in
genitive, *ex gratia.*

i Zimmi Zami Zi ya li Zwa Lizwi Lami.
Sheep (of) me they do it hear voice (of) me.

Bearing in mind that vast portions of the te
tory of the Bántu language field have only
imperfectly explored, or not explored at al
adopt provisionally the classifications into t
main branches, the southern, the eastern,

rn. Each of these are again subdivided into ranches, which are sufficient for present sities, but which, as regards the eastern and ern must be indefinitely extended as time on, to admit of proper classification of the es of languages which come under observation. s classification is mainly dated on geographical a. In the southern branch there are three sub-anches (1) Kafirland; (2) Bechuána land; (3) kza. In the first sub-branch we have the two est languages of the Ama Zulu, and Ama Xosa, monly known as Kafir. It is the furthest moved from alien contact, and therefore the most; the people understand the handling of heir speech, and make long and orderly orations. It may be presumed, that this was the earliest of Bántu immigrants; the marked resem-blance of the languages of the eastern branch with the languages of the western branch seem to indicate that they both belonged to a later and temporary stream of immigration. Other nguages are recorded in this branch, Ama ..., Ama Fingu, Ama Zwasi, and Matabéle, nd north of the Zambési we come into contact with tribes called Maviti, Watuta, or other names, who are clearly of Zulu origin. It has been fully strated by scholars and grammarians, and there s large literature.

The Bechuána-land sub-branch comprises the guages of the majority of the vast population ich occupies the interior of Africa south of the pic of Capricorn, intermixed with Bushmen and f-blood tribes. They are separated from the ir sub-branch by the Drakenburg range; thward they extend to the Orange River, west-d to the Kalaiiári Desert, and northward as as the Lake Ngami. Being powerful, they e brought under subjection tribes belonging to eastern and western branches of this family. re are two divisions of this sub-branch, the ...n and western. The Eastern Bechuána tribes the Basúto, who speak Sesuto; the Batan, speak Setan; the Ba-tsetse, who speak ...tse; the Ba-mapela, who speak Se-mapela; Ba-puti, who speak Se-puti; the Ba-tloung, speak Se-tloung; and others. The Western ...ina tribes are the Ba-rolung, who speak ...lung; the Ba-hlapi, who speak Se-hlapi; the khwena, who speak Se-khwena; the Ba-kaa, speak Se-kaa; the Ba-mangwato, who speak ...ngwato; the Makololo; and the Marutse-...nda, on the Zambesi River, described by Dr. ...ub. The words of this sub-branch sound harsh, its pronunciation offers a striking contrast to melodiousness of the Zulu, to which language, ...ver, it has a greater resemblance than to the ...r. There are no clicks in this sub-branch; there is an abundance of linguistic and educa-...l works, for which we are indebted to the ...onaries.

...e third sub-branch of the southern branch is ...ekeza, spoken to the north-east of the Kafir ...ranch, and some distance to the north of ...oa Bay, and in the neighbourhood of ...zo Marques. A remarkable linguistic phe-...non is vouched for by Dr. Bleek, that the ... occupying the entire coast-line of Zululand to speak Tekeza languages, which they ...bandoned in favour of Kafir. Some few of ... tribes are said to speak among them-selves Tekeza languages. Clicks are unknown, except in those dialects which have come under Zulu influence. The southern and Zuluised tribes of this sub-branch are the Ma-neólosi, about 2,000 in number, in Natal; the northern are the Ma-tonga and Ma-hloenga, living near Delagoa Bay. The former seems to be a generic name for a variety of tribes inhabiting the interior of the Portuguese coast. Nothing has been published to illustrate the language of this sub-branch.

The eastern branch of the Bantu family is the creation of the last 20 years of exploration and missionary enterprise. The outlines of the great kingdom may be marked out with certainty; we must leave to future generations to fill in the details of the picture. No book that has passed under my observation has attempted it yet. I divide this eastern branch into three sub-branches:—I. The Basin of the Zambési. II. Zanzibár. III. Victoria-Tanganyika. Under each sub-branch will be given the boundaries assigned to their territory. The whole will make up the region included in this branch.

The first sub-branch, the Zambési basin, comprises an ever-increasing number of languages spoken by the tribes which come into contact with the missionaries, who have lately invaded that river and Lake Nyassa; the boundary of this sub-branch on the east extends north to an imaginary line separating it from the Zanzibár sub-branch, and on the west as far into Central Africa as exploration has extended. Considering the extremely scanty extent of materials, this grouping must be deemed entirely provisional, and only a convenient mode of collecting the names of languages known to exist in a certain territory. It is only by constant study of the narratives of travellers and missionaries that information can be gained, but the scientific character of the informants gives a value to what they state far beyond the random jottings down of the ordinary traveller. So far as it goes, it is accurate, but it goes only a very little way. We gratefully acknowledge a dictionary of some standing of the Nyássa, by Dr. Rebman, and a modern grammar of that language, by Mr. Riddell, of the Free Church Mission. This is the language of Lake Nyassa, and, if cultivated, and made the vehicle of instruction, will extinguish its weaker rivals. The Makúa is a language of great importance, occupying the table-land betwixt that lake and the Mozambique coast; it has been illustrated by an accomplished scholar, Mr. Maples, of the University Mission. Adjacent to or intermixed with the above, is a tribe called the Yao, or Hiau, or Ajáwa, whose language has been illustrated by Bishop Steere. Vocabularies exist of most of the others, and their habitat is generally known.

The second sub-branch is the Zanzibár; this extends from the island of Ibo, on the confines of the Mozambique territory, along the coast of the Indian Ocean, to the confines of the Galla and Wakuafi, where the Bántu family meet the tribes of the Hamitic and Nuba-Fulah groups already described. It embraces all the low coast, and the range of mountains running parallel to the coast, from the confines of the Zambési sub-branch, to the country of the Masai of the Nuba-Fulah group. The dominant language throughout this sub-branch is the Swahéli, the speech of the coast,

as its name indicates, deeply affected by Arabic, used by Mahometans, and expressed in the Arabic character, and influenced by Arabic culture, but unintelligible to the savages of the interior. Those savage languages are being slowly developed by the labours of the missionaries. For the Swahêli all has been done, that is required, by Bishop Steere and Dr. Krapf, but of the other languages we have little more than brief vocabularies, or short notices, but it is a promise for the future to have got so much. It gives some idea of the rapidly expanding knowledge to mention that Frederick Müller only gives three languages of the sub-branch, which, owing to the diligence and energy of explorers, is now so rapidly expanding. It is pleasant to read in the reports that such a one is busy at the languages, has grammars and vocabularies, or a translation of a Gospel, in hand, all of which will find their way into my hands, and this is going on all down the line; and the funds are entirely provided by religious societies, who thus indirectly contribute to the extending of science.

The third sub-branch, that of the Victoria and Tanganyika Lakes, has been formed at a date entirely subsequent to the latest information available to Frederick Muller, and is the result of Stanley's famous journey across the Dark Continent, and the two great religious missions planted by the Church Missionary Society and London Missionary Society in answer to his challenge. If in five years so much has been done, what will be the result at the end of a quarter of a century? In connection with Victoria Nyanza many languages have been indicated, and their existence substantiated. In the language of the court of the King of Uganda, a portion of the Scripture has been translated; of the Nyamwezi we have a grammatical notice by Bishop Steere. The northern boundary of this sub-branch is the line of contact of the Negro, Hamitic, and Nuba-Falah groups already alluded to. On the east it is conterminous with the Zanzibár sub-branch, and to the south with that of the Zambési. To the far west an imaginary line must be drawn due south from Nyangwe on the Lualába (which Stanley proved to be the the Kongo), until it reaches the Zambési. Beyond that point the languages recorded must be entered in the western branch of the Bántu family, until, in due time, we have collected enough material to establish a separate group or family, as the case may be, for Central Africa south of the Equator, and north of the Zambési, which, with the exception of the track of Cameron, is now wholly unknown. In connection with Lake Tanganyika we have information from the south, owing to the exploration of the Geographical Society, and the visit of the Free Church Missionaries from Lake Nyassa. We have English missionaries established on one part of Lake Tanganyika, and French Roman Catholic missionaries at another. Nothing of a tangible linguistic character has reached us yet, but we are enabled to record the names and position of the tribes speaking distinct languages, or, possibly, dialects of languages, and leave it to time to fill in the picture. Nothing that is published can escape my observation, as every report, French English, or German passes under my notice.

The western branch of the Bántu family comprise the western half of Africa from the Namáqua-land of the Hottentot family to the Equator, beyond it to the island of Fernando Po, and Cameroon Mountains on the main-land. northern boundary is that of the Negro gr and to the east, the imaginary line drawn Nyangwe to the Zambesi, thus leaving the l spaces of Central Africa to the explorer fro west. This branch has three sub-branche Angola; (2), Kongo; (3), Ogoway-Gabún.

The Angola sub-branch comprises the Her Damaraland, and the Shindonga of Ov within British protection. and illstrated by g matical and religious works. Crossing the Cunéne, we enter the Portuguese settleme Western Africa, and find a row of langua which our information is imperfect. Bunda best known, and is illustrated by gram works; but as to the language spoken in t terior, towards the kingdom of Muáte Jan know nothing. Serpa Pinto has brought to the Gwanquella language, spoken in the ba the Coanza.

Passing northwards, we come to the sub-b of the Kongo, reaching into the interior as Niangwe. Stanley, in his "Dark Continent," given us some glimpses of languages spok the Equator; and as we approach the Atlanti have fuller information from missionaries travellers. Stanley himself is in the field; there are English and French missionaries pu their way forward, and every year will add t information. All those dreadful cannibals obstructed the progress of Stanley down the K will come into this category.

From the undefined confines of the sub-b of the Kongo basin, to the frontier of Negr north of the Equator, stretches the sub-bra the Ogoway-Gabún, including the islands c coast, and the Cameroons. Here we have s well-defined languages, illustrated by several of considerable merit; the Fernandian, the Mpo the Dikéle, the Dualla, the Isubu, and the B For every scrap of linguistic knowledge in tracts we are indebted to the missionaries. limits of the sub-branch may be indefinitely p into the interior; and on the confines of Negr we may expect to find linguistic phenomena, sideration of which may throw light into the of both the Negro and Bántu stock.

VI. Driven down to the extreme south o continent of Africa, and only saved from e tion by the advent of the English, and b efforts of Christian missionaries, we find the and last linguistic group, and which, but f smallness of the population, ought to form groups, as the compenent parts have no rel whatever to each other. I allude to the gro the Hottentot and Bushman. Their existen however, important, as throwing some light o character of the earlier, if not aboriginal, in tants of the continent, as, unquestionably, we to deal with tribes broken and reduced b powerful inroad from the north of the great I family.

Sub-group "Hottentot." However, the may be spelt, or from whatever cause assigned not the real name of the tribe, who call them "Koikoib" (Men of men), and are called "L by their Kafir neighbours. They number 5 and are considered to have four dialects—

est and standard, spoken in Namaqua- the north; Kora, on the Orange River; is spoken by the Eastern division of the and a fourth, and a very impure variety, neighbourhood of Capetown. To these added the Griqua, or Bastards, the issue ch and Hottentot, speaking a mixed ge. There are many excellent works by aries about and in this language, and it considered to be sufficiently well-known, all probability, its days are numbered. ick Muller records his opinion, that it is an language, with no connection with any African or non-African form of speech, morphologically agglutinative, the roots nosyllabic; there are genders and numbers by suffixes; the pronoun is the vivifying ele- and joined to nouns and verbs, differentiates ning. The oral literature consists of songs imal stories, which have been collected by hising scholars. The great feature of nguage is the existence of four clicks, by a different position of the tongue; ntal click is almost identical with the f indignation, not unfrequently uttered by ns; the lateral click is the sound with orses are stimulated to action; the guttural not unlike the popping of a champagne nd the palatal click is compared to the of a whip.

ety of opinions may be quoted as to the ical origin of the Hottentot. Hovelacque that he is but a cross-breed, and that, may be said to the isolation of his , he has no pretence to independence of Max Müller quotes Dr. Moffat as an y for a resemblance of the Hottentot with that of some of the tribes of the ile. Such assertions must, at the present f the inquiry, be supported by actual first hand, or withdrawn, as if supported hearsay statements, they are of no We must deal with actual facts, and in ence, it is of no use hazarding theories of ic race extending in a continual line down le continent of Europe. No doubt the ot and Bushman are like the Basque in the survival of an ethnological and c stratum, which has disappeared else- and, in the absence of written records, left behind. Bleek and Lepsius, whose names y be mentioned with profound respect, the Hottentot with the Hamitic group.

ames of scholars whom we should aid to with this portion of the subject are, W. heophilus Hahn, Henry Tindall, Wallmann, derick Müller. To them we are indebted ammatical notices, vocabularies, and a con- e amount of educational and religious e. A missionary being invited by the nent to send books in the Kora dialect to ed, remarked, that his experience was that asier to teach the young to read Dutch, the old could not learn at all.

roup "Bushman" comprises one isolated e, and is a very low state of linguistic nent. The name was assigned to them by h, because they dwelt in the bush; they selves Saab or Saan, and are totally dis- m, and shunned by, the Hottentot and Bántu. The language belongs to the monosyllabic order, as far as we can judge; there is no gender, the formation of the plural is exceedingly irregular, and, of the sixty ways of forming it, reduplication of the noun is the most common, as the most natural; but the use of the plural seems to be as abnormal as the formation. In some particulars there are analogies common to the Bushman and the Hottentot. Dr. Bleek made many years' study of this subject, having members of the tribe in his household, and collected materials for grammar, dictionary, and folk-lore, before his premature death. We can only hope that his successor, Theophilus Hahn, will complete the unfinished work.

It must be remembered that the Bushmen are a broken and despised race, in the lowest state of culture, neither pastoral, nor agricultural, but living by hunting, and nomadic; they have no appearance of tribal unity, and no chief. Before the English rule they were treated as little better than wild beasts. The "click" sounds are believed to be their original property, and to have been communicated by them, in always decreasing pro- portion, to the Hottentot and Kafirland sub- branch of the Bántu family; for the Bushman, in addition to the four clicks already described as a feature of the Hottentot language, has a fifth, sixth, and sometimes a seventh and eighth, and not only before vowels and guttrals, but before labials. Such sounds are almost incapable of ex- pression by Europeans, and it would almost appear that they are connecting links between articulate and inarticulate sounds.

The Bushmen are of exceedingly small stature, thus opening out the question of their belonging to the now well-established tribes of pigmies in North and Central Africa. In appearance they seem to belong to the lowest order of humanity; they inhabit outskirts and desert places, and are shy and wild. We read, however, of tame Bush- men, the Babomuntsu, on the outskirts of the Basuto country, and other tribes with mutually unintelligible languages, with evident traces of Bántu influence in their form of speech, both wild and tame, within the recognised territory of Bántu sub-branches. Only lately it was mentioned by Miss Lloyd, the sister-in-law of Dr. Bleek, that a Bushman, who resided beyond Damaraland, had come under her notice, whose language was unin- telligible to the Bushmen at Capetown. Frederick Muller states that they are found even as far as the Rivers Cunéne and Zambesi, and even beyond. If such is indeed the case, we are not in a position to arrive at any final opinion about them.

One remarkable feature still remains to be noticed. No trace of the invention of writing has been found south of the Equator, but the Bushmen have acquired a wonderful power of painting scenes on rocks and in caves. Animals, human figures, dancing, hunting, fights, are pourtrayed with fidelity, and that the art has existed down to modern times is evident from the appearance of Boers in some of the fights. It appears that the art of sculpture was also known, and that the out- lines of some of the figures are excellent.

Here ends my task. Twenty years ago there was a rebellion against the tyranny of the Arian and Semitic scholars, who attempted to cut down all languages to the length and breadth of their

method, forgetful of the infinite variety of the then dimly-discerned families and groups of agglutinating languages in Asia. The great problem of the origin of language, however, cannot be solved, and is not ready for solution, until the secrets of the languages of Africa, Australia, and America are revealed, and arranged in such order, that the lessons taught by the study of each of them may be considered with reference to the linguistic phenomena of the whole world, and this work will not be completed in this generation.

DISCUSSION.

Dr. Koelle said he could but express his delight at hearing that so much progress had been made in this country in the study of the African languages, since the time when he was occupied with the same subject, about thirty years ago. As an illustration, he might mention that, when he went to Sierra Leone in the year 1847, it was generally supposed that about thirty different languages were spoken in that colony, but his researches proved that there were upwards of 100. The Continent of Africa had been called dark, mysterious, and unknown, but it was now evident that it had, to a great extent, ceased to be unknown. Nevertheless, he was struck with the observation that, although we had made great progress in our knowledge of the Continent and its languages, there was still much to be done. For instance, it was mentioned that there were eleven unclassified languages, which showed that we might look forward to eleven new families of speech. As a matter of detail, he could not agree with the statement that the mode of writing adopted by the Vei people was not original, because it certainly had no connection with any other mode. It was a new invention, a syllabic mode of writing, and the Vei people had only a slight acquaintance with the European and Arabic methods, which were both alphabetical, consequently it was altogether new, and the marks themselves were also quite original. Mr. Hyde Clarke had traced some of them to the very old alphabets, but, as far as he could ascertain, there was no historic connection, only a physiological one. As far as the character of the writing was concerned, it was perfectly original. Again, the Negro languages were represented as being similar to the Turkish, as being agglutinative, but this would perhaps turn out not to be correct. For instance, the Damara language, which he had reduced to a grammar, was not agglutinative, and the same might turn out to be the case with a number of others. He was also struck with the remarkable character of the language in Darvar, of which he had an opportunity, some ten years ago, of collecting specimens from a black man in Jerusalem; it was a most singular language, but not agglutinative.

Mr. Cust asked if it were monosyllabic.

Dr. Koelle said no; it was exceedingly guttural, and the numerals were quite extraordinary, altogether different from those of any other African language with which he was acquainted. He hoped, from what had been already accomplished, that we might hope for still greater progress, for certainly a great deal yet remained to be done.

Mr. Hyde Clarke said he must join in the tribute which Dr. Koelle had paid to Mr. Cust for this paper, which all who had paid any attention to the subject would know must have involved an immense amount of labour. It did not appear to him that there was any need for apology for bringing it forward, and a full vindication was given, not only in the reasons he had mentioned, but in the very remarkable facts to which he had called attention. He had shown from the experience of the missionary societies that the simple propagation of religious tenets tended to the promotion of external science, and the lal sionaries in East and West Africa wer foundation for the promotion of the arts a which it was the object of the Society t was mainly by the study of the language like Africa, which possessed so many, t come into contact with the population and material interest, as well as the spiritua which the labours of missionaris were devo studied and written a good deal on thi might be excused for differing in some po Cust, because he could only say, as had said, that from year to year we had to alte on these matters. For instance, on one p Mr. Cust had called attention, the lang short races of the Bushmen and the Akk he had the materials furnished him b Geographical Society, he was led at one ti the opinion that these languages formed a feature, that there were assuredly relation the various short races in the world. Wi tion, however, of the real nature of lang him to materially alter his opinion. So fa concerned, it was a matter well worthy that right across Africa there was a series races, and that they were found in other world, speaking languages which indir common origin. He regretted that he co the explanation of the distinguished scho Müller, as to hair having any connection tribution of language; but must accept dictum of Mr. Cust, that language c admitted in any way as a testimony of that great scholar came to make further ex would find that the very languages which buted to populations having one character c by others partaking of different ethnologica As to tufted hair, anthropologists cons artifically produced. Latterly he had bee attend more to the two groups which Mr. C Nubah and the Negro, and, as far as his ex there was no black population in the wor language which, to all intents and purpo termed a white language, and there was n lation but spoke what, if you chose, you black language. In the preface to the m grammar of the Bornu language, by I gave most decided specimens of the rela Bornu words and forms of grammar languages of the world, and he might ha still farther. He himself had gone the l ing that the Houssa language might be more than 200 words, with the Kolaria might compare the language of the Sant lately in rebellion against us, with that o whose assistance we hoped for in the thre the West Coast. It would, he though advantage to the missionary cause, if from that district were sent to labou among the tribes in India. In the another distinguished scholar, the Rev. there was an observation bearing or He had studied this subject quite free from sions, and must be pardoned for differin great authorities, and he could not but se main, he found all the languages of the w excepting the Bushmen and Hottentots, l connection. Then came the difficulty wl put forward, how was it possible th could be related which differed so m words; surely there could be no affi languages having such different vocabula Dr. Koelle had pointed to the conf agglutinative and inflexional languages, found that the grammatical forms distrit out the world were connected in a sh The question to be determined was,

ect, according to the old system, to assume re was one primitive language of one set ls, or whether, on the other hand, there was stem of language, in which several words were d to one idea, and possibly several ideas to d. Mr. Cust knew that even with regard to ptian and Coptic, there were several words with an one idea attached to them; and so it was the pre-historic languages, whether you went Caucasus, to Africa, or to America; for it had ought out by the researches of the American ent, that the same feature prevailed in the sign of the American Indians. If it were the at there were many signs used for one word, ight well be a very varied distribution of sounds. another question, how was it possible to together, correlate, and compare these dis- materials. There he thought Mr. Cust would have applied to other very distinguished in Germany, who were studying psychological y, such as Dr. Karl Abel. They studied sounds, but the ideas represented, and thereby tained further criteria; they found two ideas d which were represented by one sound, and sound likewise representing those two ideas; re got, in the end, a means of checking other ions, and arriving at exact results from dis- materials. In conclusion, he would say, that ct was of great practical value to the future ent of Africa, besides being a matter of the moment for the progress of philology and ogy. Mr. Cust had briefly pointed to one reason for this. Africa had never been con- those great conquerors who altered the anthro- and linguistic boundaries of Europe and Asia, tribes had been preserved. It was necessary, to guard against the confusion of race with It by no means followed because we found pulation speaking a particular language, that be the language of that race. Therein, he lay a great part of the fallacy of Frederick In Liberia or Sierra Leone there were large ulations speaking English, and we knew how obtained that language, but there were similar s in a state of utter savagery, speaking of equal culture, although of a different form, ld be correlated with the remains of other of antiquity. In fact, we had living languages ustration of Kluta, Babylonian, Etruscan, Iberian, and what was once most celebrated, most obscure, in the ancient world.

. W. Wright (of the Bible Society) thought practical value of this paper was that Mr. shown as it were the tide-mark to which p had risen on this subject, and it would be sting in a few years to have a similar paper, how much progress had been made in the It was interesting now to look at old maps and see what was known nine or ten years then take maps brought up to the present owledge, and mark the difference. He was sed with the scientific manner in which Mr. treated the subject; not dogmatically, for s were generally put forward by men who ey knew all about the subject, simply from rance of what the considerations of the ere. On the following day he should have to the committee of his Society a letter from ere, showing that his assistants were all ike bees, and the New Testament was now Redman did the Gospel of Luke, but Bishop pleted the other parts. Mr. Hyde Clarke be glad to hear that the New Testament had ated in the Housa language, and that the ent was in progress. He must correct one in the paper, viz., that Bishop Steere thor of the gospel in Yah; it was Mr. Maples. He also thought it would be well for Mr. Cust to suspend his opinion as to what part of the world we owed language to, until more was known about the inscriptions now being published by the Biblical Archæological Society. The whole Bible was now being printed in Basuto, and the work was going on in the Yoruba, and several other languages. He might promise the whole literary world that any translation made in Africa that came to the Bible Society attested they would print. He hoped that in the future, when kindly missionaries went into the country, and kindly explorers, instead of the greedy adventurers who had preceded them, and the more cruel imperialism that had touched the country at different points, they would stir up a kindly response in the hearts of the people, and that the travellers would be received into the country, and be able to explore, to their roots, the different languages.

Mr. Brandram said he had read about the African languages, as a student, but he had no special know- ledge of any of them. Of late he had turned more attention to them on account of the light which they threw on the gender. This question of the classifica- tion of languages in accordance with the gender, had nothing to do with their relationships amongst them- selves necessarily; but they apparently learned more about gender from these African languages, than from any other in the world. They saw it there completely developed, and apparently in embryo; and although those who studied the matter might hold the most opposite theories, it was to the languages of Africa they all appealed. He had classified the African language, for his own satisfaction, into three divisions; the Hamitic and Semitic, as having the most highly de- veloped gender, in which the distinction of sex was the basis; then there were the Bántu languages, in which the distinction was based rather upon animate and in- animate considerations; and then there were the Negro languages in the centre, in which there was no distinc- tion of gender at all, except the embryo, in the shape of prefixes and suffixes, which, according to Dr. Bleek, might ultimately develop into gender. He must add his testimony to the great value of the paper, in which all the information existing on the subject was brought together, and the authorities were referred to; a work of immense service to students, who otherwise might waste valuable time in doing what had been done already. He believed Mr. Cust was now doing for the African languages what he had already done for the Asiatic, and he begged to thank him for it.

Mr. A. W. Mitchinson, author of "The Expiring Continent," said that philologists were often in error in their explanations of the derivation of roots of lan- guages. This arose from depending too much on theories and book-knowledge alone. A more accurate idea could be obtained only by personal acquaintance with natives. He had met Bushmen in Africa, whose words were the same as those of other tribes far distant on the same continent. The character of the country and population had altered since ancient times, and this had led the philologists to erroneously ascribe the origin of language to several places instead of one. The migration of people from one country to another influ- enced the character of the native languages. He found in his travels in Senegambia, on the Gambia River, and in Equatorial Africa, that many words as *osoka*, *otchag*, *idoo*, *tega*, &c., were both in meaning and sound exactly the same as Russian, Persian, Arabic, Hebrew, and other Oriental languages. The speaker mentioned that some of the natives in Africa had tails four or five inches long, derived, according to the tradition of the natives themselves, from gorillas or "devils," who had stolen native women. He concluded by denying that any of the natives of Africa were cannibals, except in cases of starvation, but stated that on the other hand they were great dog-eaters.

Dr. Mann remarked that the skill of the Bushmen in drawing, to which reference had been made, was a matter of considerable interest, and he himself had had some opportunity of noticing it. At one time, in the neighbourhood of Natal, there were a number of Bushmen who gave a deal of trouble, by coming down at night on the frontier of the colony, stealing horses and driving them away to the caves which they inhabited in the mountains. After some time, consent was obtained to send an expedition out to disperse them, and in a skirmish some were wounded, one of whom was taken prisoner. He appeared to be a lad, though it was not always easy to tell who were boys and who were old men. Having been cured of his woundsin the hospital at Pietermaritzburg, he was taken charge of by one of the magistrates, Mr. Proudfoot, with whom he lived for several years. This lad was very skilful in drawing, and it was often an amusement to call him out, and get him to show how he did it. He began by simply placing a number of isolated dots on the slate, or whatever he had to draw upon, which then resembled a constellation of stars; then after pausing, and carefully looking at these dots, he would carefully connect them together, until an animal grew up out of the outline, and you could tell at once what it was, whether a horse, a buffalo, or an antelope. He stated that that was the invariable mode of drawing, and he, Dr. Mann, had some reason to believe that it was so. A short time since, Mr. Francis Galton having expressed great interest in the matter, and a desire to have the facts carroborated, he had written to Mr. Proudfoot to ask if he could send him some drawings, but unfortunately he found that the poor fellow died about two years since of consumption. From his acquaintance with this man, he very much doubted the generally accepted notion of the very low organisation of the Bushmen. Though small in stature, they were quick in perception; and though their craniology was peculiar, it did not appear to indicate low organisation. This question was a very difficult one. One of the finest collections of skulls in the world was that of the Royal College of Surgeons, and some little time since he obtained five characteristic skulls of Zulus, from the field of Isandhlane. All those five were of a very distinct type, and Professor Flowers said a Zulu skull might be detected anywhere after having seen them; yet one of those sculls was, with one exception, the largest in the whole collection, though it belonged to a man who would probably be spoken of as a low organisation savage. Why the Kafir and Negro races, with such fine crainal development, were so backward in social civilisation, he did not undertake to say, but it certainly was not due to lowness of organisation.

The Chairman, in proposing a vote of thanks to Mr. Cust, said he could not pretend to any knowledge of the philological questions treated, but other gentlemen present, who were able to judge, had spoken upon this topic. His only excuse for occupying the chair was that, while at the Cape, he took a great interest in the ethnology of the various native races, and that he was fortunate enough on his return to be able to give Mr. Cust some materials which were of use to him. He also had the pleasure of being intimately acquainted with the late Dr. Bleek, and he need hardly say that he did all in his power to forward his investigations, especially in connection with the Bushman language; and he agreed with Dr. Mann that that was a most remarkable tribe, and by no means one of the lowest in organisation. It must be interesting to the Society of Arts to know that it was owing to a former President, the late Prince Consort, that Dr. Bleek was able to go to South Africa at all to prosecute his researches, and he might add, that for several years he received aid from the Prince's private purse. While out there, unfortunately, his untimely death put a stop to his studies, except so far as they were continued by his sister-in-law, Miss Lloyd; but he was glad to hear that the Cape Government had now filled up his place by the appointment of Mr. Theophilus H highly recommended by Professors Ma Sayce, and from his linguistic requiren perience in the interior, they might l results. He was surprised to hear t remained to be done in almost every pa continent, especially amongst the Ba Central Africa; but Mr. Cust had render by classifying and putting into a cond that was known about these languges, would serve as a sort of sketch for missionaries going to Africa. He had reminded them of the debt they owed t missionary societies, without whose aid what he himself and other students had would have been possible.

The vote of thanks having been passed

Mr. Cust, in reply, said he hoped one the paper would be that Dr. Koelle woul his slumber of 25 years, and again turn h the subject of the African languages. If up his own book as a basis, and add to his later experience, he would be doi service.

THIRTEENTH ORDINARY ME

Wednesday, March 2nd, 1881; F BRAMWELL, F.R.S., Chairman of th the chair.

The following candidates were] election as members of the Society:—

Appleby, Herbert, Durnlea, Littleboroug
Attwood, George, F.G.S., F.C.S., 7, Regent's-park, N.W.
Hall, W. H., Weybridge-heath, Surrey.
Rattray, Netlam, 70, Gloucester-terrace,]
Richardson, Captain John Frederick, Houghton-house, Stoneygate, Leiceste

The following candidates were ball duly elected members of the Society:

Branston, F. R. E., 23, St. Swithin's-la 66, Lillieshall-road, S.W.
Dollman, Charles, 293, Clapham-road, S.
Greenwood, A., LL.D., Flaxfield College
MacCallum, Andrew, 47, Bedford-gard ton, W.
Wilding, Samuel P., 23, Rood-lane, E.C

The paper read was—

LIGHTHOUSE CHARACTER]

By Sir William Thomson, D.C

For a lighthouse to fulfil the re existence, it must not only be seen recognised when seen. Besides its lig lighthouse generally contains also, for thick or foggy weather that the ligh seen, a sound-making appliance, tl which is not only to be heard, but wh be immediately recognised to be itself else. Mr. Price Edwards, in his com the Society of Arts, of 15th Decem "Signalling by means of Sound," gave ing and clear description of the ch methods hitherto in use for this exc

lition to the efficiency of light-houses; have occasion to return to the subject ristic sounds, in relation to the several nich have been adopted to give characlities to the light itself of a light-house. side colour, now generally admitted to sible, as a distinction for lighthouse pt in the proper use of it, which is to different directions of the light by ctors to mark rocks or other dangers, limits of navigable channels, we find racteristic qualities of lighthouses to r one or other of the following three s:—

Flashing lights.
Fixed lights.
Occulting or eclipsing lights.

-known name "Revolving lights" is limited to flashing lights; but it ambiguity, because the same revolving is also applied in many cases to proeclipses of "Occulting or Eclipsing he official description of the revolving e "Admiralty List of Lights," is as

volving light, gradually increasing to then decreasing to eclipse. [At short l in clear weather a faint continuous light ved.]"

fact, includes the description of the nt :—

hing—showing flashes at short intervals, or shes at regular intervals."

ation of the fixed and flashing qualities, paratively rare, constitutes an importeristic light, described in the Admiralty vs :—

7.—Fixed light with addition of white or hes, preceded and followed by a short

nave really very little of complexity in nental classification into the three of Flashing, Fixed, and Occulting.

hing light, the light is visible for only a a fraction of a second, or from that to conds—and then disappears; and, for a r time than the duration of the flash, nvisible, until it again flashes out as the fixed light there is no distinguisheristic whatever, but merely a light g continuously and uniformly. The ght is visible during the greater part ke a fixed light, shining continuously ly. Characteristic distinction is given clipse, or by a very rapid group of two ort eclipses, or of short and longer rring at regular periods, "flashes of s they have been called, cutting out, from the light its mark, by which it inguished and recognised to be itself else, in the very short time (from halfne least, to seven seconds at the most) the group of eclipses.

I.—FLASHING LIGHTS.

ago, in every flashing light there e flash in the period, and thus the he period was the sole distinction between one flashing light and another. Thus, in the "Admiralty List of Lights for the British Islands," for 1875, we find about 100 flashing lights of different periods, from the four-seconds' period of Ardrossan Breakwater light to the two-minutes, period of the upper light of Lundy Island, of the South Stack, Holyhead, and of one of the lights on Slyne Head, off the west coast of Ireland; and the distinction of each one of these 100 lights was solely its period as a simple flashing light, except in cases in which the objectionable distinction by colour was put in requisition. When it was determined to choose periods the same, or nearly the same, for neighbouring lights, it was found necessary to add distinction by colour, objectionable as this is if not enforced by necessity. Thus, for for example, the Gull Stream lightship, in the fairway between the Goodwin Sands and the Kentish coast, is a revolving light of twenty seconds period, while the East Goodwin lightship, about six miles from it, is a revolving light of fifiteen seconds period. Without greater accuracy than is generally to be found in the time-keeping of flashing lights, even on shore, the distinction between fifteen and twenty seconds could scarcely be relied upon, as given by the mechanism; and even if given trustworily by the mechanism, the distinction could only be discovered by the sailor with certainty by the aid of a chronometer. To give a sufficient distinction between these two lights, therefore, it was found necessary to use colour; the East Goodwin was made green, the Gull Stream white. Again, the St. Agnes light, Scilly, and the light on the Wolf Rock, two far outlying lights, about twenty miles asunder, are each of them of half a minute period from flash to flash, and the sole distinction between them is, that the flashes of the Wolf light are alternately white and red, while those of the St. Agnes' light are all white.

The insufficiency of the distinction of flashing lights, merely by length of period, had come to be felt so strongly, that a very important fresh distinction was introduced in 1875, in the lightship then first placed on the Royal Sovereign shoal; the Group Flashing Light of Mr. Hopkinson, in which, instead of just one flash in the period, there are, in the case of the Royal Sovereign light, three flashes in the period, or, as may be in other cases, two flashes, or four flashes, the interval between the successive flashes of the group being much shorter than the interval from group to group in the whole period. In two cases in the English Channel, the North Sand Head and the Casquets, the new triple flashing light was introduced, to replace, by a group of three flashes in rapid succession, three separate lights which had been the characteristic arrangement previously; three fixed lights in the case of the North Sand Head, and three simple flashing lights in the case of the Casquets.

Mr. Preece has imprudently pointed out that Mr. Hopkinson's triple flashing light is the letter S of the Morse-Colomb flashing alphabet. Sailors, we may hope, are happily ignorant of this truth. The proverbial captain of the collier does not read the *Journal of the Society of Arts*, or he would be calling out to his chief officer —"Bill, was that a S, or a I, or a H, or a E.?" Bill, if he was well up in dramatic litera-

ture, would reply, "Captain, them is things as no fellow can understand." I must say, however, that I agree with Mr. Preece, and think that, while many may find memory aided, none can be embarrassed, by an official statement of the Morse letter corresponding to any group of flashes or eclipses that may be chosen as the characteristic for any particular light. This, however, is a matter of comparatively small moment at present. The great thing is to find how lights may be most surely and inexpensively rendered distinctive, so that no sailor, educated or uneducated, highly intelligent or only intelligent enough to sail a collier through gales, and snowstorms, and fogs, all winter, between Newcastle and Plymouth, may know each light as soon as he sees it, without doubt or hesitation.

This object is fully attained by the triple flashing light, if quick enough. The triple flashing light of the Casquets, and of Bull Point (Bristol Channel), which are the quickest of the kind hitherto made, complete their three flashes in twelve seconds, after which there is an interval of eighteen seconds of darkness. These are, no doubt, very admirable and thoroughly distinctive lights; but it would be very much better if they were made three times as fast, which, with the existing machinery, could, I believe, be easily done. If this were done, they would show their flashes each in two thirds of a second, and with only a second of time between. Thus, the three flashes completed in four seconds, would be instantly recognised as a group of three, without the necessity of any counting either of flashes or of numbers of seconds of time in the intervals between the flashes; and, instead of having to wait in darkness for eighteen seconds the sailor would only have to wait six seconds, for a repetition of the triple flash.

The *Royal Sovereign*, the *Seven Stones*, the *Newarp* (near Yarmouth, on the east coast), and the *Saltees* (off the south coast of Ireland), all lightships, supplied within the last few years with the Triple Flashing Light, are, each of them, of one minute period, of which there is thirty-six seconds of darkness, and twenty-four seconds of flashing. These lights are all too slow to do full advantage to the Triple-flash system. When one of them is first seen, it is very apt to be confounded with an ordinary "revolving light;" that is, a single-flash flashing light. Even somewhat careful watching—at all events if the weather, or the distance from the light, be such as to leave any room for doubt—does not always immediately resolve the doubt. A sixfold quickening of each of these lights would greatly enhance its distinctive quality, and would make it really fulfil the condition pointed out by the Elder Brethren of the Trinity-house, as the object to be aimed at in every modern lighthouse, "That he that runs may read."

The satisfactory distinctions of Group-Flashing lights are exhausted in the groups of two or three or four flashes; because, to count five or six, or more, would be embarrassing, and liable to mistake at sea. It has been proposed to obtain further distinction, by using groups of longer and shorter flashes, as in Captain Colomb's Flashing Telegraph, now in general use, and very thoroughly appreciated both in the Navy and in the Army; but there are optical difficu way of making, with satisfactory econon of long and short flashes, separated intervals of darkness in the group, and tively long intervals of darkness between groups; and considering how very n useful and satisfactory at sea is a l showing long light with short interval ness, than even the quickest of flashing does not seem desirable to push the dist flashing lights further than the double, quadruple groups. The periods for th which seem best adapted for practical all things considered, but most partic value to the sailor, are as follows:—

Number of flashes in period.	Duration of each flash.	Duration of group.
One............	$\frac{1}{4}$ sec.	$\frac{1}{4}$ sec.
One............	$\frac{1}{2}$,,	$\frac{1}{2}$,,
One............	1 ,,	1 ,,
Two	$\frac{1}{2}$,,	2 ,,
Two	1 ,,	4 ,,
Three	$\frac{1}{2}$,,	$3\frac{1}{2}$,,
Four	$\frac{1}{4}$,,	$2\frac{1}{2}$,,

It may be objected to the suggesti preceding table, that the quarter-second too short to be perceived with the sam as flashes of five or six seconds duration. I alone can answer decisively the questio with equal maximum brilliancy in each f of quarter-second duration recurring seconds, or one of half-second recurring seconds, or one of one second recurring seconds, is the most easily to be seen at tance, or in hazy weather. From physic periments already made, it has been con one-tenth of a second is a long enough t excite the sensibility and perceptive powe and it seems probable that rapidity of re the contrasts between light and darkness positive advantage to the quicker flash to perceptibility, even when the observ what direction to look for the light; an does not know exactly in what directi which is the practical case of a sailor at to pick up a light, shortness of the tim bility is of supreme importance. All t sidered, it seems most probable that tl second flash recurring every two secon very much more easily and surely picked cally at sea than a flash of one second every eight seconds.

Before passing from this subject lights, I may be allowed to say that I fi my impression of the vital importance o in a light from a very practical man, the in 1866, showed us within a quarter of mid-ocean, where to find the cable been laid and lost in 1865; Captain Mor I well remember when, on one occasio 1858 or 1865, I do not know which, in Irish coast in dirty weather he said:—

"Those lighthouses should flash out thei like your electric signals; every lighthouse and flash, and flash, many times in a minu you which lighthouse it is every time.

the revolving light has often seemed to me e, when I have been anxious to make out were in a gale of wind and rain."

II.—FIXED LIGHTS.

623 lights numbered in the "Admiralty ights for the British Islands for 1881," 490 , 112 are flashing, and 21 are occulting psing," or "intermittent"); and similar ons are to be found in the official list of or other parts of the world. Thus it that fixed lights constitute the great . The fixed light has a great advantage t to practical usefulness over the flashing being always visible. The superior bril-roduced by optical condensation of the g light is, in some respects, dearly economy, when the great diminution lness to the sailor, in its comparatively iods of darkness, is taken into account. who praise the revolving light unquali-r its superior penetrative power, seem to e counterpart in optics to the great prin-lynamics—that what is gained in power speed: in flashing lights, what is gained ncy is lost in time of visibility. The pain-ious scanning of the horizon for a one-ashing light, is known to every one who had occasion to look for one in practical n; and the comparative ease of picking l light, and keeping sight of it when it is difficult circumstances, is thoroughly ed at sea by sailors. Still, if the revolving be seen at all, whatever be the difficulty g it up, and whatever the annoyance sight of it and having to pick it , it has fulfilled the object of a light-All are agreed in the maxim that nd requisite of all sea lights is pene-ower;" and if the fixed light cannot t a distance, or in weather in which the light is seen, the fixed light has failed, evolving light has done its work for the It depends very much on the special nces whether the same quantity of light, t uniformly as a fixed light, or con-d given out in flashes, with comparatively rvals of darkness, as in the revolving etter in respect to being seen. In stormy le weather, with heavy showers of rain or e fixed light is much safer than a one-volving light of much greater absolute , as several successive flashes of the re-ght may be lost through passing showers, fixed light loses no chance of being seen ls between the showers. On the other hazy or foggy weather of tolerably steady , a revolving light can be seen efficiently ater distance than the same absolute of light, given out uniformly as a fixed

question of economy, the great first cost ical apparatus, special to the revolving st be set against the greater consumption gas, or fuel, to obtain in a fixed light, t be an oil or gas lamp, or an electric light, brilliancy. In many cases, indeed, the f the money spent on prisms, and lenses, anism in the revolving light, and in some st beautiful and perfect of the appliances for the azimuthal condensation of fixed lights, would supply the oil required to give the same, or nearly the same, brilliancy all round the horizon. These circumstances are, of course, all to be taken into account by the proper authorities in respect to every project for a new lighthouse. But we have actually at present the great fact of 490 fixed lights on the coasts of the British Islands; and when it is considered desirable or necessary to give more brilliancy to any of them, this certainly is not to be done by converting it into a flashing light, but by making it a more powerful oil or gas light, or converting it into an electric light. Indeed, after Mr. Douglas's communication of two years ago (March 25th, 1879) to the Institution of Civil Engineers, on "The Electric Light Applied to Lighthouse Illumination," and the discussion which followed upon it, and considering the great progress which has been made since that time in lighting by electricity, we can scarcely doubt that, in the course of a few years, nothing but the electric light will be thought of for any new lighthouse of great importance.

The great defect of fixed lights at present is the want of characteristic quality by which the sailor, when he sees a light which really is a lighthouse light, may immediately feel sure that it is so, and not a steamer's mast-head light, nor a trawler's or fishing-boat's light, nor a light on shore other than a lighthouse light; and that knowing it to be a lighthouse, he may know exactly which of two or more possible lighthouses it is. The need for thorough-going remedial measures to remove this defect has been more and more felt of late years, and is now very generally admitted. Unless a second light is to be added, or the generally objectionable expedient of colour for distinction is in any particular case to be admitted, the only systematic means of giving characteristic quality to a fixed light is by means of occultations or eclipses; and hence the origin of the "Occulting" or "Eclipsing light." We may accordingly look forward to all, or nearly all, the important fixed lights of our coast being, without any very long delay, converted into lights of this class. It is satisfactory to find that during the last year the elder brethren of the Trinity-house converted one most important light, that of the North Foreland, and another very important one, the light on the west end of Plymouth Breakwater, into eclipsing lights, and that a similar improvement has been promised for five more of the fixed lights under their charge (Mucking, Lowestoft, Chatham, Flatholm, and Evan) within the official year 1880-1.

III.—OCCULTING OR ECLIPSING LIGHTS.

The 21 eclipsing lights at present existing in the British Islands are described in the Admiralty list of lights. (See next page.)

To these is to be added the Cardross light on the Clyde, at present a red light, but which, before the end of next month, is to be converted into a white eclipsing light of the same character as the Craigmore light in Rothesay Bay, long-short-long-short. It was judged by the trustees of the Clyde Navigation, under whose charge this light is, that the long-short-long-short would be thoroughly free from liability to be mistaken for the occulting light (short-short) off Garvel Point,

Occulting Lights of the British Islands, 1881.

No.	Name.	Place.	Period.	Remarks.
12	Plymouth	On W. end of breakwater	Half-minute.	The light suddenly disappears every half-minute.
107	North Foreland	On head	"	The light suddenly disappears every half-minute.
282	Tarbet Ness	430 yards from the extremity of the point	3 minutes.	Visible 2½ minutes, eclipsed ½
305	Ru Stoer	South ear of Ru Stoer	1½ "	" 1 " " ½
315	Hebrides, Barra Head	Highest part of Bernera Island, South point of the Hebrides.	3 "	" 2½ " " ½
339A	Craigmore, Firth of Clyde	End of pier, Bogany point, Bute Island	11 seconds.	Five seconds of light, follo eclipses, long-short-long-sh
347	Greenock	Garvel point	8 "	Light for four seconds, wit eclipses in the next four se
361	Troon Harbour	Inner end of pier	1 minute.	Visible 40 seconds, eclipsed
373	Galloway Mull	S.E. extreme	¾ "	" 30 " "
418	Ribble River	S.E. of Stanner point, N. side of entrance	4 "	" 3½ minutes, "
442	Lynus	On the point	10 seconds.	" 8 seconds, "
454	St. Tudwall	West Island	10 "	" 8 " "
494	Bristol Channel Burnham	E. side of entrance of Parret River	4 minutes.	White with Red Sectors, visibl eclipsed ½ minute.
512	Cork Harbour	Roche point, E. side of entrance	20 seconds.	" 15 seconds, "
521	Mine Head	S. side of head	1 minute.	" 50 " " 1
536	Wicklow	On the head	13 seconds.	" 10 " "
542A	North Bull, Dublin Bay	End of North Bull wall	14 "	" 10 " "
555	Dundrum Bay	St. John's point	1 minute.	" 45 " " 1
562	Belfast Bay	On elbow of Hollywood bank in 8 feet water	12 seconds.	Eight seconds of light, foll short and one longer eclip
566	Rathlin	Altacarry head, N.E. point of island	1 minute.	White with Red Sector, visibl eclipsed 10 seconds.
600	Loop Head	500 yards, E. by S., from extremity of head	24 seconds.	" 20 " "

three miles from it, and would, in the circumstances, give it a more telling characteristic quality than a single eclipse in the period or than any group of three eclipses.

It will be seen, from the preceding table of occulting lights that, with the exception of Holywood Bank light, Belfast Lough, and Garvel Point, and Cardross lights, all on the Clyde, the distinction in each case is only a single eclipse in the period, and that except in nine of them, the period is one minute or upwards, but in all, except five, the duration of the eclipse is less than half a minute. In all the more recent eclipsing lights the period is half a minute or less, and the duration of the eclipse is at most five seconds. The tendency undoubtedly is to quicken the action still farther, following the example of the old Point Lynus light, with its eight seconds of visibility and two seconds of eclipse.

The necessity for a very short period is not so urgent in the case of eclipsing lights as it is in the case of flashing lights. A long period in the case of a flashing light means a long period of darkness, throughout which the light is lost sight of. The inconvenience of a long period in an eclipsing light is merely the length of time during which the sailor may have to wait to know which light it is; he never loses sight of the light except for the two or three seconds' duration of one of the eclipses. But quickness of each group is just as important to allow ready and sure identification of its character as is the quickness of a group of flashes in the group-flashing lights, of which I have already spoken.

The important question is now to be met—How may eclipses be best arranged to give the requisite number of characteristic distinctions, for the large number of fixed lights on our coasts which need distinction, with as little as may be of interference with the valuable quality of fixity? *The answer*, I believe, is by groups of eclipses described as follows: — First—one, t or four very short eclipses, say of than one second each, separated intervals of light in the group, and the eclipses following one another after in not less than eight seconds of undisturl light; next groups of two or of three long eclipses, the short eclipse one se long eclipse three seconds, the interva between the eclipses of a group or and the interval of undisturbed light the groups of eclipses not less than eigl I fixed upon the time one second after many trials of mechanisms to pr eclipses, I found that I could produ groups of eclipses at the rate corresp one second for the short eclipse by a s inexpensive machine applicable to a house, large or small, and of any variety arrangement, whether merely with co to the horizon, or with the additional required to condense into a particular az

A machine fulfilling these conditions i work in the college tower of the of Glasgow, performing the short-long the following table for four hours every It has been doing this for a month, and signs of wear. Indeed, there is no p machine which is liable to wear in the years' regular service in a lighthouse. In machine at present, because it has been that the plan of mechanism used in the Bank light, and Garvel Point, Craig Cardross lights, that is, a mechanism eclipses by revolving screens, and theref able only to lights without azimuthal con is the only mechanism which can practi duce the groups of eclipses at the speed to carry out this method of giving cha qualities to fixed lights.

My proposal for giving character to fi

nt definitely limited to the ten varieties the following table. The short eclipse second, the long, three seconds, in every pt the last; in the last case, the short a half-second, and the long eclipse, three nds:—

scription of the eclipse.	Time from beginning to end of each group of eclipses.	Period of time from beginning of one group to beginning of the next.
ng.	3 seconds	12 seconds
ort.	1 ,,	10 ,,
ort-short.	3 ,,	12 ,,
ort-long.	5 ,,	15 ,,
ng-short.	5 ,,	15 ,,
ort-short-short.	5 ,,	15 ,,
ort-short-long.	7 ,,	20 ,,
ort-long-short.	7 ,,	20 ,,
ng-short-short.	7 ,,	20 ,,
ng-short-long-short.	11 ,,	20 ,,

vious this plan may be understood im- by any person learned or unlearned e description, or being told it by word , and that no knowledge of the Morse rresponding to the several groups of s needed. Indeed, if Mr. Preece and d not let out the secret, I might have forward this proposal without any lgment of indebtedness to Morse or to Colomb, had I been disposed to omit to t where credit is due for very brilliant ble inventions, and had I thought only y best way of putting forward my little n in the manner most likely to promote doption by the lighthouse authorities.

nly to add, in conclusion, that the highly suggestion of Sir Richard Collinson, to h and a low note in direct contrast, to acteristic sounds for lighthouses, may be ut systematically in a very convenient y using the combinations of the preced- with a high note instead of the short nd a low note instead of the long he low note of the same duration as the ; the interval between the notes of each ut the same as the time of each blast; and al of silence between the group of blasts ger than the whole time of each group. fog-syren is used, there is no difficulty in e blasts as short as we please, and they ought not to be longer than a half-second uarters of a second. Quickness is here, as ther nautical matters, of vital importance. e try for himself, sounding a high and a in rapid succession, or two high notes , or any other of the combinations of the table, and he cannot fail to be con- ere is in each case a characteristic sound, ds no musical ear for its appreciation, and not be misunderstood by anyone who has r has read it as the description of the sound of such and such a lighthouse, or has been told of it by word of mouth. The distinction between long and short blasts, as Mr. Price Edwards pointed out in his communication to the Society of Arts, already referred to, has not proved satisfactory in experience, and I believe this will generally be admitted to be the case by those who have experience of the working of the Morse system of long and short blasts of the steam-whistle or syren at sea. There is an uncertainty as to the instant when the sound ceases, prolonged as it often is by echoes, and in the case of the steam-whistle, an uncertainty also as to when it begins, which is very distressing to anyone trying to understand Morse-signals by long and short sounds. But corresponding signals by very short high and low notes following one another very quickly, with ample times of silence between the groups of sounds, are exceedingly clear, and may easily be distinguished, even when the sounds are barely audible.

racteristic is very easily read, and may be used with a cases in which there is no practical difficulty in nds corresponding to the times half-second and three for the short and long eclipses.

DISCUSSION.

Dr. Tyndall, F.R.S., said there could be no doubt of the importance of the subject of the paper, to which he had listened with much pleasure, or of its growing importance, because the greater the number of lights there were, the greater was the liability to confusion between them. It was, therefore, a matter of growing necessity to be able to distinguish between lighthouses from other lights afloat and ashore. It might be imagined by any one who had been near to a lighthouse, especially if lighted with the electric light, that it could not possibly be mistaken for a floating light at a masthead; but he could assure them it was not only a possible, but an actual mistake; a candle in a lantern, placed in a certain position, was not to be distinguished by the sharpest eye from a distant electric light. Hence the necessity for the distinctiveness on which Sir William Thomson insisted. He (Dr. Tyndall) should himself lean to his view as to the utility of quickening the flashes, so as to bring them within the range of consciousness, and to present them without the labour of counting, or, at any rate, of looking at a watch. The Elder Brethren were by no means oblivious of the necessity for distinctiveness, and the beautiful apparatus devised by Dr. Hopkinson, for a triple or other flashing light—for he was not limited to the triple flash—and constructed in the workshops of Messrs. Chance, was obtained with the view of securing this object; and in a paper read by Mr. Douglass before the Institute of Civil Engineers, an elaborate scheme of signals was brought forward. He had been much interested in the experiments, which showed how easily gas lent itself to such purposes; and he might remark, that on the South Coast of Ireland there was a first-class lighthouse illuminated by gas. There a light of 300 jets of gas could be almost quenched and raised again in an instant by the simplest arrangement. With regard to the siren and sound signals generally, he might say that, at the present moment, the Elder Brethren were engaged in investigations. Sir Richard Collinson's proposal to use high and low-pitched notes in combination was of great value, and this would render the siren stations as distinct as he hoped the lighthouses soon would be. There was, therefore, a very healthy movement on the part of the Elder Brethren, which would be greatly promoted by the zealous efforts of Sir William Thomson, who brought his own individual experience to bear on it, who was fettered by no particular antecedents, but who had simply and solely at heart the welfare of the seafaring population.

Dr. Hopkinson, F.R.S., thanked Sir William Thomson for the kind way in which he had spoken of his

efforts to devise an apparatus for making distinctions, the importance of which he had so forcibly urged. He had put very clearly the advantages of flashing lights, by reference to the dynamic law that what was gained in power was lost in speed, which was strictly true. But, optically, the light you did not get when you did not see it, you did get concentrated in one flash when you did see it. With an ordinary light, giving a single flash of four seconds, with a period of half a minute, you got seven and a-half times as much light in that flash as you would with a fixed light burning the same quantity of oil. That advantage was very great, and could not even be made up by burning seven and a-half times as much oil, because, if you did that, you would have a larger source of light to deal with, which would throw greater difficulties in the way of the optical engineer. The greatest part of the diminution of light at a distance was due to absorption by the air, which was a larger cause of limitation than that due to the diffusion over a greater area, in proportion to the distance, so that if the weather were at all thick, the light might be reduced to 1-10th, 1-20th, or even 1-100th for every mile of distance, so that if you increased the power seven or eight times, you would not increase its range in the same ratio, particularly in thick weather. For all that, it was of vital importance to push the lights as far to sea as possible. With regard to the Royal Sovereign and Casquets, they were of a totally different character, so far as optical arrangements were concerned, the former being a floating light with catoptric apparatus, a series of reflectors with a flame in the focus of each; and with the construction of that light he had nothing to do. The Casquets was a dioptric light with a single flame in the focus. Sir William Thomson had urged that these large dioptric lights would be greatly improved if the revolutions were made much quicker, and he quite agreed with him, but in the case of the Casquets experiments had been carefully tried, at 15 seconds and 30 seconds, and he believed the opinion of those most experienced was that the half-minute light was the better. There was, however, a great difficulty in running these heavy lights at the speed suggested, not from any difficulty in making machinery strong enough to stand the wear and tear, but in getting the motive power; that could be only obtained from the sinews of the light-keepers, and his opinion was that at the Casquets those sinews were already taxed somewhat severely. Indeed, if ever a light-keeper were inclined to strike it would be at being called upon to make these heavy three ton apparatus revolve at a velocity which would give a triple flash every ten seconds. At the Bull Point, the labour had been somewhat reduced by improving the machinery. With regard to eclipsing lights, he did not think there would be any difficulty in having a reasonably rapid group of flashes, either with Sir William Thomson's machine, or with the one which had been for some little time in use in English lighthouses, and which had lately been introduced in China. These were first and second order lights, and the eclipsing screen, which was made of sheet iron, rose and fell something like two feet in some cases as rapidly as in half a second, which speed was quite sufficient to meet any ordinary requirements.

Captain Sir George Nares, K.C.B., F.R.S., said if seamen had not the "three F's," they had "three L's." Sir William Thomson had helped them to improve each. They were, the lead, the log, and the look-out. He had improved the lead; he had improved the log by improving the compass; and now he was trying his utmost to improve the lights and so help the look-out. But with these numerous distinctions they would have to educate the seamen, even the intelligent captain and his mate, to understand them. The Board of Trade were advancing very fast in the matter of examinations, and Sir William Thomson would do a great deal of good if he could induce the officials of the d examine captains and mates in these matte they had not the slightest idea of any distin a flashing and an eclipsing light; they both revolving. Sir William Thomson letter S, and they were ready to accept single, double, or triple flash, or even fou he did not think he was yet sufficientl he saw two lights, one on each side short and long, and the other long and tinguish readily which was which. Thomson was working in the right d they did not want to go too far. They seventy distinct characters of light on the c ought to be enough. Before going furthe to be well educated up to what they had a

Captain Ladd (of the Trinity House) sa be forgotten that a floating revolving li times the penetrating power of an occulti dash light, and Mr. Hopkinson's light, a plained, had seven times the power. In he agreed with Sir George Nares.

Dr. Gladstone, F.R.S., desired to echo an that had been said as to the importance o Many years ago it occurred to him that on important improvements in this matter distinction between lights; every lighthou readily distinguished from lights on th lights, and so on, and to be distinct fr bours. Before coming to the meeting, h to the report of the Royal Commissi houses, of which he was a member, pri and there he found it was laid down that should be placed on any important position, the reason being the evident were apt to be confounded with ships' lig other lights on shore. There was also t in a revolving light, as had been explai was gathered up and concentrated, so th much greater distance. Last summer, from Swansea to Ilfracombe, he had mu seeing the Bull Point light arrayed wit son's apparatus; there was a distinction could see at once, the two short flashes interval of darkness following them, and cessive days he watched it with great inter had the pleasure of examining the apparat into the report which he had mentioned, he had entirely forgotten, that a gentle recently become notorious in another Pelham Dale, brought before the Commi for the distinction of lights identica with that now advocated by Sir Willi He suggested that lights should ha than ten distinctions; that they sho Roman numerals by occultations; that a tion should represent the I., and a so that if the number were IV., you w mark to represent the I., and another to V. He also drew out a scheme for marki lighthouses in a similar way by dayligh flags, and by suitable sounds in fogs. Th ought certainly to be carried out all ro and a very few would suffice. He did go with Sir William Thomson in what he preference for occulting lights over re appeared to him that the former had two One was, that during the obscuration you amount of light, which was not utili in a revolving light; and, secondly, yo have such a penetrating light. There w the argument, that what was lost in one gained in another; but it seemed to him minent points on the coast it was advis revolving light like that on the Casquets which should be more rapid in action than

other places, where it was not necessary that should carry so far, the occulting light might ith advantage.

ggins said he remembered the two terrible hich occurred 40 or 50 years ago between and Cape Grisnez, of the *Reliance* and *eror*, involving an immense loss of life, ere caused by these ships mistaking the light for Dungeness. From that time, the es of both countries had done their best to e lights so distinct that such an accident t occur again; but yet, during the last winter, p had been wrecked near Boulogne from the e. It was all very well to watch the experi- that room, but it was a very different thing to th the flashes on a dark winter's night in a He, for one, did not think they would be dis- d by the most intelligent captain in the Royal the captain of the finest steamer. The cap- colliers did not care about them; they took to pass any light until they knew what it was. ulty was with the captains of fruit schooners om the Azores, racing up to London with a ho wanted to know what light it was they first in the English Channel, when perhaps they uite correct either in their latitude or longitude. d hail with satisfaction any practical plan ld enable the sailor to do so, but he thought the stem was far superior to the one now proposed. l from a description by Mr. Brassey, of his the Bay of Biscay, with a fine ship and a w, to show that it was possible to mistake a sthead light for a green light; and he had en found it impossible, on coming into the hannel, to see any light at all. In summer fine weather he could distinguish perfectly ghts on the Goodwins from his window, at but in winter time, very often he could not t all.

H. Preece said if he had been imprudent in ces, as Sir William Thomson suggested, how e imprudent had he been himself, who was o suggest to him at the meeting of the sociation at Brighton, that the proper system ouses was to adopt the Morse alphabet. e the dream of a telegraphist, but he who nearly all his life reading signals by ashes, high notes and low notes, and other the kind, would not have the slightest n reading off by these flashes of gas-light a livered by Sir William Thomson, and he ward to the day when the lighthouses round hould shout out not in audible, but in visible to every nation on earth its name and If it was a dream, it was certainly within the practical engineering, and gradually, but Trinity Board, and the Board of Trade, were he necessary education, in which they were helped by the persistent efforts of reformers illiam Thomson. But whilst they were being p to the Morse alphabet, Sir William Thomson e running away from it, so as, in many other ght be said that extremes met, and so it would they had their lights established on a principle o ran might read. A flashing system no d counting, than the words Trinity House lling. If those words were written up in cters, the whole group would convey the idea House at one glance; and so, whether you Morse alphabet, or the flashing system, or g system, if you simply applied a system he eye was enabled to grasp at one view the name of the lights, you attained exactly the as if you printed the word. That was the ir William Thomson was advocating, and would continue writing papers and pressing forward the subject until the Trinity House adopted a sensible system.

Dr. C. W. Siemens, F.R.S., said the subject was one of great interest to him, but he had not given sufficient attention to the details to be able to speak with any authority upon it. He might say a word or two, however, on the probability of seeing the electric light established for the purpose of giving those flashes which had been referred to. He might certainly say that the electric light appeared destined to take the place of all other lights for that purpose. In dealing with light produced by the com- bustion of oil or gas, they were necessarily limited to the amount to be obtained under given conditions. A large amount of light could be obtained by combustion, but it could not be concentrated within the focus of a lamp. It was only by the electric current that small surfaces could be heated to a point far exceeding the temperature attainable by combustion, and send out rays of light second in energy only to those of the sun. It had been proved by St. Clair Deville, and Bunsen, that the utmost temperature to be obtained by combustion was about 2,400°, when a point was reached at which combustion ceased and dissociation set in; and therefore it was impossible to obtain rays of high intensity by means of combustion. There were, no doubt, practical difficulties to be overcome in apply- ing the electric light to some situations where power could not be easily raised; but means of producing power were continually being improved. Where you could not raise steam you could decompose oil; and where you could not work a steam-engine you could a gas-engine or an oil-engine, as was already done in the United States to a large extent. With the electric light also an admirable system of flashes of any desired rapidity could be attained; and he would conclude by expressing a hope that they would soon attain the desired point when each lighthouse would not only tell its own tale, but also give that information to the greatest possible distance.

The Chairman said it must be borne in mind that, in listening to this paper, they were not listening to a mere scientific man, unacquainted with the practical details of seamanship, for there was no more ardent yachtsman than Sir William Thomson in all England; and they would all remember the way in which he indignantly repudiated the idea that the man who, in the midst of storm and tempest, could navigate a vessel along the shores of England, from New- castle to London, with a cargo of coals, was not a man of intelligence, or that he could not do as much it was said a crow could do, viz., count four. Sir William Thomson had already given to navigation a sounding implement and a compass, now very largely used, and he was the apostle of this doctrine of the identification of lighthouses, the necessity for which was so apparent that it was not necessary to take up time by dwelling upon it. It was better to be without a light at all, than to have one which was misleading; and it was to prevent this mis- leading, which became more and more likely every day, having regard to the fact that a white light, in a light- house at a distance, could readily be mistaken for another white light in the immediate neighbourhood, that this system was devised. Sir William Thomson, by his persistence in this matter, was doing infinite good, and was likely to save many lives which were now lost in consequence of the mistakes made in distinguishing one light from another. A supposed quotation from the Bible had been made more than once, and, as usual, it was misquoted. They had been told of a light, "which he who runs may read," whereas it should be "that he may run who readeth;" in other words, that what was read should be of such a terrible character, that he who saw it ran away from it.

Sir William Thomson, in reply, said he would first

read an extract from a letter which had been put into his hands since the discussion commenced. It was from Mr. J. R. Wigham, of Dublin, one of the great improvers in gas appliances for lighthouse purposes; and he said:—"Knowing a little of the efforts which are being made by the Irish Lights Board and their scientific adviser, Dr. Tyndall, in the direction of the plan you advocate, I thought I would mention that they have at last obtained the consent of the Board of Trade, to fix a group flashing gas-light at Copeland Island." With regard to Dr. Hopkinson's statement as to the possibility of giving the rapidity he desired to a triple-grouped flashing light, he could only say that the difficulty be had mentioned was no doubt real, and he did not wish to have anything very extravagant attempted; if it were to be a severe tax on the light-keeper to make the Casquets light much quicker, he should prefer leaving it as it was. He only wished to keep rapidity in view, in all cases in which it can be attained; and although it was said that double speed was not so good as that adopted, it did not follow that that quadruple speed would not be much better. They might look forward to much greater speed with the electric light, with its extreme pliability in respect of stopping and starting. The electric light on the tower of Glasgow University, during the exhibition of gas and electricity, in October last, constructed by Messrs. Latimer Clarke and Muirhead, gave identifying occultations, long and short, in the most admirably perfect manner, by extemporised mechanism, and worked with all the quickness desired. Sir George Nares spoke of 70 distinctions of lights, but what he had brought forward was a plan for simplification. Instead of 70 distiuctions of an unsystematic character, he proposed to have only two classes, flashing and occulting, each divided into nine varieties. He certainly should not like to have to distinguish between a long and short on his right hand, and a short and long on his left, but wherever there were two lights near each other, on the two sides of a channel for instance, the difference should be made as marked as possible. The Chairman had used an admirable expression in speaking of the identification of lights; that was what he wanted, that each light should identify itself. He did not approve of either numbers or letters being associated with the signals, but preferred long-short, long-short-short, and so on; still more did he object to anything like spelling names, which he had been most mistakenly accused of recommending. He had even been accused by a scientific expert, in a lecture, of having proposed to the Clyde Navigation to spell out C.U.M.B.R.A.E., though in the very building in which the lecture was given he had specimens of lights giving identifying signals such as he described. With regard to the question of the flashing and fixed light, as stated by Dr. Gladstone, he preferred the fixed light, and the character given by the occultations for the reasons he had stated, but he had endeavoured to weigh, as fairly as possible, the respective advantages, on the one hand of never losing sight of the light, and on the other the greater brilliancy. Dr. Hopkinson had pointed out why, even by increasing the consumption of oil, the fixed light could not reach the brilliancy of the flashing light, except by gigantic optical appliances; but even assuming all new lights were of the flashing order, there were 490 fixed lights, and what was to be done with them? The experience of Mr. Brassey, as quoted by Mr. Liggins, proved conclusively that a white light might be mistaken for a green one, which showed how necessary it was to have some better means of identification. Lastly, he wished to say that he had not quoted from the Bible at all, but from the Trinity Brethren.

The **Chairman** then proposed a cordial vote of thanks to *Sir William Thomson*, which was carried unanimously, and the proceedings terminated.

MISCELLANEOUS.

SILK-PRODUCING BOMBYCES REARED

By **Alfred Wailly**

(Membre-Lauréat de la Société d'Acclimatation de l

(*Continued from page* 285.)

Telea Polyphemus (North America).—This ı which produces a closed cocoon, a little sma that of *Pernyi*, is the best of the silk produce United States of America. The silk is white, and seems to be of a very superior quality. easily be bred like *Pernyi* in the open air, in unless the weather should be exceptionally ba *phemus* is now acclimatised in Spain, where I ir it in 1879. In 1880, some 1,500 wild cocoons lected from oak, birch, and other trees. It polyphagous. My Spanish correspondent *Polyphemus* as a valuable acquisition to ser in Spain, but he says it has a tendency t double-brooded there, two male moths having in November. The larvæ thrived well on bir *alba*). My correspondent in Alabama, fro I have just received some *Polyphemus* which are very small, and covered with le species of ever-green oak, says it is double-b Alabama, as it must be in all the Southern America; in the Northern States it is single-l

Samia Gloveri.—In 1880, I received a large ı cocoons of this North American bombyx. T collected, my correspondent wrote to me, som south of Salt Lake City, Utah, in a locality v never been previously explored. As far as I l informed, this fine species, up to the present, been found in Utah and Arizona. The coc collected in plantations of a species of wi small narrow leaves. The cocoon, somewhat s smaller than that of *Samia cecropia*, is gene silvery grey outside; the rough envelope adh cocoon inside, which is of a very dark bro *Gloveri* moths emerged from the middle of Ap middle of July, but no pairings could be obta

Samia Ceanothi.—This species, a little sm *Gloveri*, is a native of California. The mot vary in shades of colours like *Cecropia* and *Gl* ground colour of the wings is of an unifor brown; the bands and markings are pure whit partakes of *Ceanothi* and *Cecropia*, as if it we between these two species.

The cocoon of *Ceanothi* is very different fro *Gloveri* or *Cecropia*; it has the open end ver and is pear-shaped; its colour is iron-grey. cocoon is brown, and small, compared to t envelope.

The moths of *Ceanothi* (of which I had n cocoons) emerged from the 3rd of April to th July; a perfect specimen had emerged in Ma pairings only were obtained. The larvæ bred o willow did not thrive, and died in first and sec a few going into third stage. From a letter r ceived from one of my German correspondent Wolff, of Breslau, I hear that three coc obtained by this entomologist with only six e disposal, a very great success, considering th has attended the efforts of several others in t of this species.

The first pairing of the *Ceanothi* moths took the 27th of June, the second on the 10th of ova of the first brood hatched 18 days, and th second, 15 days after having been deposited.

The larvæ, somewhat similar to those of the first and second stage, but of a ligh showed a marked difference in the third

thus:—Back of body, sky-blue; sides, greenish r; tubercles, golden yellow all along the back, and e sides, blue; head green.

brids.—Although *Samia gloveri* moths refused to among themselves, I had several crossings between ri, *Ceanothi*, and *Cecropia*. The ova obtained from g pairing between a *Ceanothi* female and a *Gloveri* were the only ones which were fertile. Unfortu-ly the larvæ, reared on willow and plum, all died, reaching, like *Ceanothi*, the third stage. The pair-d *Ceanothi* and *Gloveri* was from the evening of the the evening of the 21st of May. The larvæ from the 15th to the 21st of June, the majority hatched on the 16th and 17th of June. All the ed, excepting a few; over 200 in all. First larger larvæ, black; smaller ones, buff, the becoming of a more uniform hue as the larvæ in size. They were very much like *Cecropia* Second stage — Larvæ, yellow, with black ; head, black. Third stage—Back, bluish; yellow; tubercles on back, orange-red; tubercles blue; head, yellow.

larvæ, the produce of a pairing of female *pyri* with unknown *Samia* (the pairing was not lived seven days on plum; they were bright , with a dark ring round each segment.

other crossings resulting from the keeping of species together in large cages, when male and moths of the same species could not be obtained neously, are the following:—In a hot-house, at ner's, on the 22nd of May, *Telea polyhemus*) with *Attacus mylitta* (male), of the Bombay race; *lyphemus* (female) with *Attacus pernyi* (male); *loveri* (female) with *Pernyi* (male). In my house, nary temperature, on the 12th and 13th June, *eanothi* (female) and *S. cecropia* (male); on 15th . *gloveri* (female) with *S. cecropia* (male); on the d 19th June, *S. cecropia* (female) with *S. ceanothi*

In all the above cases, the ova were unfertile. difficulties I have experienced to obtain living from India and other distant countries, induced October to write an article on the collecting and of larvæ, and on the best plan to be adopted for ling of cocoons and pupæ, so that they should n England in good condition. This article was India, China, and South Africa. It appeared in rth-*China Herald*, of November 25th, 1880, and *Madras Athenæum* and *Daily News*, of Saturday, ber 4th, 1880. It was sent also to correspondents rtion in the *Times of India* (Bombay), the *Calcutta man's Overland Mail* and the *Cape Argus*.*

ns residing abroad, who may be willing to collect r larvæ of *Lepidoptera*, will find this a most in-g and instructive study. It is within the reach of l is at the same time profitable, as the pupæ and obtained would be purchased from them by other rs. Larvæ can be found in almost unlimited rs by using a sweeping-net over low plants, or ing bushes, shrubs, and trees, placing an umbrella he branches to receive them. Larvæ which hide lves in the day time can only be found in large rs by looking for them at night with a lantern.

rearing of the caterpillars, after a little ex-e, will be found extremely easy. Some will to be placed in cages, when active and apt to ray; others, like the silk producing Bombyces, e reared uncovered on branches plunged into care being taken to use long branches (never wigs) when the larvæ are large. When very small es are used, the foliage becomes too watery, and cause the death of the larvæ. Cut leaves have to rwed too often, and therefore should be avoided, l the larvæ whenever cut branches plunged in an be used. Branches should also be cut in the evening or early in the morning, and not in the day-time when the sun is hot, as, in the latter case, the foliage would soon be faded. When trees in pots can be used to feed the larvæ, the rearing is, of course, more simple, and there is a saving of time. Another plan, which is the best to rear larvæ forming cocoons in the leaves or on the branches, is to place them on the living tree in the open air, taking care to protect them from birds.

To give fresh food to larvæ reared on cut branches kept in water, when the foliage has been eaten, or is too old and dry, is very easy. The old branches are merely placed in contact with fresh branches, or the old branches cut in pieces (not to be too heavy) are placed on the new ones. The larvæ, which should not be handled, will leave the old branches to go to the fresh ones. In a short time the old branches, bare of larvæ, may be removed.

When branches are plunged in a bottle, or any other vessel containing water, the foliage at the base of the branch should be cut off, as leaves in the water would decompose it, render the rest of the foliage unwholesome, and even poison the larvæ. The cut branches in water should be placed in the shade, where they will keep fresh for several days, especially if the foliage is sound and healthy, a condition of great importance. The water should be renewed, and the foliage freed of green flies and other small insects.

To rear *Lepidoptera* from the egg the moths should be placed in cages for pairing and depositing their eggs. With moths of *Sphingidæ* and some other species, it is useful to put in the cage a bunch of aromatic flowers, with branches of the plant the larvæ feed upon. Moisture should always be maintained in the cages.

A few days, or immediately after the eggs have been obtained, they should be placed under a glass with a small branch or leaves of the proper plants, so that the larvæ should find their food as soon as they are hatched.

When the larvæ are small, I rear them under bell-glasses, having a few holes on the dome. These glasses, which are of various sizes, according to the number of larvæ, rest on saucers full of sand covered with a piece of paper. Small branches of the proper food plants are struck through the paper and plunged into the sand, where they keep fresh for several days without requiring any water.

The larvæ, under a bell-glass, can be watched and kept perfectly clean, for, after having removed the glass, it is sufficient to blow on the paper to remove all the dejections. Some larvæ may thus be reared till they turn into pupa state, under glasses one foot high and one foot in diameter, or larger, according to the size of the larvæ. With larvæ of the large silk-producing and other Bombyces, after the first or second moult, when they have ceased to wander, it is best to rear these without the glass covering; branches plunged in water are then used, as mentioned before. The larvæ should be reared in the open air, but sufficiently protected, or in a well ventilated room. Larvæ which go into the ground to turn into the pupa state should be reared in cages containing a few inches of light soil or soft sand, and this plan must always be adopted when the habit of the larvæ is not known.

Now, with respect to the sending of living cocoons and pupæ from abroad, on the cases there should be written in large letters, "living pupæ," or "living cocoons of silkworms," with request to keep the cases in the coolest place, or in the ice-house of the vessel. The cocoons should be well packed in straw, hay, moss, or anything that will deaden the shocks to which the cases may be subjected. Pupæ of lepidoptera must be placed in bran, sawdust, or fine moss. Cocoons and pupæ should be sent as soon as possible after their formation, from the beginning of October to about the beginning of April, according to distance, so that they should not be subjected to the heat the whole of the time during their voyage to England. Small quan-

* n a letter just received from Major G. Coussmaker, I hear article appeared in the *Times of India*, and also in the griculturist.

tities of cocoons and pupæ should be sent by sample post, in registered boxes, not exceeding the legal weight; the boxes must be strong, and it is best to tie a label to each box, and affix the stamps to the label. Persons living too far inland to send living pupæ may send dead specimens of the perfect insects (butterflies and moths). These should be in good condition, and placed with folded wings in paper envelopes. To protect these specimens from the attacks of mites, "Dermestes" beetles, and other parasites, it is important to put some poison in the boxes containing the specimens.

With respect to the sending of live cocoons and pupæ, and even ova of lepidoptera, I may say, that with a little care, and especially if they were given in charge of the captain, or some other person on board ship, they could be sent to Europe from distant countries, and arrive alive, and in good condition.

In proof of this, I may mention the fact, that Mr. Youl, acting as agent of the Tasmanian Government, shipped in 1864, packed in a box, which was placed in the ice-house of the steamer *Norfolk*, a large quantity of salmon and trout ova, the result being the successful introduction of salmon and trout into the rivers of Tasmania and Australia.

In the same way, silkworm ova, live cocoons, and pupæ could safely be sent to Europe, from very distant countries, and this would be of the greatest interest and value to entomologists, for the study of lepidoptera in their various states.

To conclude, I shall reproduce the letter of one of my correspondents, Mr. J. P. Cock, whose death I accidentally learnt, on the 18th November last, in a house at Thames Ditton, from Mr. P. Clarke, a gentleman who is a tea-planter in Assam. This sad news was recorded in an Indian paper, the *Assam Gazette*, of October 25, 1880, which, at my request, was forwarded to me a few days after.

I now give my correspondent's letter to me, dated 14th February, 1880, and received on the 12th of March, 1880:—

"Kassia Hills, Assam.

"Dear Sir,—You must have thought it very remiss on my part, allowing your letter to remain so long unanswered, but a sudden and unforeseen calamity, in the death of my only brother, Major Cock, Deputy-Assistant Adjutant-General, Eastern Counties Districts, who fell mortally wounded while leading on his men in the final assault on Khonoma, in the Naga Hills, has entirely prevented me paying any attention to entomological pursuits for the last three months.

"My poor brother having died possessed of a good deal of landed property in no less than three of our Indian hill stations, I have been travelling incessantly winding-up his affairs; in fact, I may with perfect truth say, that for the last two months and a-half, I have been living in railway carriages and on board river steamers.

"The old adage, that misfortunes rarely come singly, I have found in my case to be true, for on my return to this station last Thursday, I found that my bungalow had been burnt to the ground through the gross carelessness of a drunken syce. Nothing was saved, a magnificent and most expensive library of entomological works, 47 large cabinets of specimens (my own private collections), my gleanings for over 26 years in Sumatra, Java, New Guinea, Borneo, Calebes, the Phillipine Islands, and Japan, over 4,000 specimens ready to forward to England, all was lost just through the carelessness of a drunken wretch capsizing a lamp in my stables.

"I keep up a staff of eight Rhapias, whom I have thoroughly trained for the work of collecting in the malarious jungles, where it is almost certain death for an European to sleep one night. I likewise have a large circle of friends and acquaintances among the officers and tea planters in the districts, all of whom I have persuaded to collect for me, and who send me what they have been able to accumulate, a[...] always take the field myself in March, and generally leave the forests before autumn is [...]vanced, many thousand insects pass through m[...] annually.

"As before stated, all my large stock of reserve[...] has been lost in the fire; however, I hope in th[...] of a month, or six weeks at the latest, to be ab[...] patch you a first consignment. I will pay p[...] attention to your wishes about the cocoons [...] various silk moths, and have already receive[...] from two intimate friends who, perhaps, are tw[...] most eminent entomologists in India, Capt. [...] and Col. Jones, both officers in the Royal En[...] They inform me that they have written to some [...] correspondents in other parts of the Himalayas [...]cure cocoons of such of the silk moths as are [...]curable here. I can, however, promise to send [...] number of cocoons of the following species:— [...] *assamensis*, *Attacus atlas*, *Actias selene*, and [...] *mœnas*. Will you kindly write to me by first m[...] the receipt of this, what cocoons do you consi[...] valuable, and the particulars that may be usef[...] in forwarding them.

"I shall probably be away in the wilds of t[...] hill forests, but your letter will be forwarded [...] out delay. I should very much like to see [...] your reports, it would give me very much ple[...] read them, and in return, will forward you [...] my book on the genus *Deilephila*, which oug[...] completed and published next month. It inc[...] the known Asiatic species of *Cherocampa*, [...] *Macrosila*, *Smerinthus*, and the illustrations, ove[...] number, have taken me nearly three years to c[...] as I have drawn each moth in water-colours [...] after capture as possible, with representation[...] egg, caterpillar, and tree on which they live.

"As the season is not sufficiently advanced [...] the field, hard frosts and bitterly cold winds pr[...] at this lofty elevation where anything in the [...] vegetation is parched and dried up, I am, at [...] hard at work on the illustrations for a work of [...] Marshall's, on "Our Indian Lepidoptera;" wh[...] pleted it will be the most perfect work on [...] lepidoptera ever given to the world, over 2,000 sp[...] illustrated.

"About a dozen of us are starting a new [...] entomological magazine; how it will answer I [...] tell; fortunately, all men concerned in it are [...] well off, so, if it fails, we shall none of us be ru[...]

"Hoping to hear from you in reply to this, giv[...] all the information in your power about the [...] I remain, &c."

After the receipt of this letter, to which I [...] three times, I never received any communicati[...] my correspondent, and, as above stated, it was [...] accident that I heard of his death.

Alfred W[...]

110, Clapham-road, London, S.W.

CORRESPONDENCE.

THE PARTICIPATION OF LABOUR IN PROFITS OF ENTERPRISE.

If it is not out of order, before the close of [...] cussion upon this important subject, which I sh[...] no opportunity of attending, I should like to [...] few suggestions upon a question which I h[...] peculiar advantages of studying, from both an [...] and employer's point of view.

That there is a great amount of wasted a[...] placed energy existing among workmen scarcely

ment; and it has always appeared to me, that
ater part of it arises from the want of personal
in the quantity or quality of work done; where
· is the only object to be gained, piece-work
› meet every requirement in this direction, the
eing regulated by the natural law of supply
nand, while bringing the best man to the front;
ere quality is required, piece-work as a rule
a failure, and some scheme of participation in
ı the only reasonable solution of the problem.
nit that any scheme of this kind will prove
if it fails to recognise the following conditions,
That the margin between a workman's earnings
daily requirements is too small to admit of its
iked to meet trade losses, even supposing work-
ld be found willing to incur such a risk; and
ed investment will never be popular among the
British workmen.
nply with these conditions, the following principle
me to be the correct one upon which to base any
of participation, and I feel sure would be found
le to a large number of our masters and men—
t if a workman, by dint of increased exertion,
plement the ordinary profits of trade, he is
ititled to one half of the amount so earned,
d to leave the other half in the hands of his
, to cover the risk of loss, for which he has
d provided. In the case of old and well-
ed concerns, this standard of ordinary profit
ı fairly arrived at, by taking the average of
and loss balance for a number of years, ex-
wer a period of both inflation and depression
; and with new concerns, by a fixed per-
covering interest upon capital invested, and a
e profit. But, in all cases, the amount divisible
ne workmen to be paid to them annually in
n their production of a qualifying certificate
in maximum of service, based upon a system
given over with their wages.
ployer, in the face of continued losses, would
option, as now, either of reducing the work-
ges, or of closing his business altogether; whilst
ent of a yearly bonus—in some cases probably
nuch larger amount than the workman was in
of receiving at one time—would lay the founda-
bits of thrift, otherwise unthought of for want
agement.
ll-known antipathy of trades unions to piece-
, in my opinion, done more to estrange the
ing which should exist between capital and
n anything else, and probably has stifled, at
time, many comprehensive schemes on the
e employers for mutual benefit.

J. B. SQUIRE.

house, Durning-road, Liverpool.
February 22nd, 1881.

RIVER CONSERVANCY BILLS.

I me the honour last week to print an abstract
arks I made on Mr. Cresswell's paper. They
ally very accurate, but there are two points
h I appear to have been misunderstood by
ter.
m made to say that I think the classification
should take place before the formation of
whereas the exact opposite is my opinion.
rict and its authority should be formed first,
rards, when Government sanction is sought
articular works a Board may wish to carry
e the proper time for the Local Government
h the aid of its inspector, to go into the ques-
w far different lands will be benefited. It
membered that what any works are worth to
er must depend upon the character and
those works; and what proportion he ought
uld be settled when the works have been de-
cided upon, and when their locality and probable effect have been announced.

If all the owners in a watershed have, before a Board can be formed, to submit to being taxed in a certain manner for river improvements still undevised in localities still unfixed, you may depend upon it more fighting than flood prevention will be the result.

2nd. I am made to say that if weirs were removed from rivers, "it would not make any difference in the level of the water." What I did say was to this effect, that there are many weirs on the Thames up which boats can be rowed during extreme floods, and that the fall at the weir, which, in such cases, must be extremely small, is an outside measure of the improvement that could result from the removal of the weirs.

R. W. PEREGRINE BIRCH.

2, Westminster Chambers, Victoria-street, S.W.
March 2nd, 1881.

OBITUARY.

William Arnot, F.C.S.—Mr. Arnot, a consulting chemist and chemical engineer, of Edinburgh, died on the 9th February, at the early age of 38, at Bridge of Allan, to which place he had gone for change of air. Although his health had been broken by a severe attack of rheumatic fever last winter, his death was somewhat sudden, and he was announced to read a paper before the Society of Arts, on the 9th of the present month, on "Improvements in the Treatment of Esparto for the Manufacture of Paper," a subject to which he had paid special attention. In the winter of 1877, he delivered a course of six Cantor lectures, on "The Technology of the Paper Trade." Mr. Arnot was born in Falkirk, where his father was an ironmonger, and in early life he removed to Glasgow to study chemistry under Dr. Penny. He was subsequently appointed chemist to Messrs. Macfie's Sugar Refinery, but, in 1868, he returned to Scotland to assist Dr. Penny in the work of purifying the River North Esk, and shortly afterwards, on the doctor's death, he was appointed successor. In 1873, he opened large chemical works at Kirkintilloch. This undertaking not being successful, he removed to Edinburgh. Mr. Arnot elected a member of the Society of Arts in 1877.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock:—

MARCH 9.—"Ascents of Chimborazo and Cotopaxi, in 1880." By EDWARD WHYMPER.

*** Members are requested to take notice that this meeting will be held at the South Kensington Museum. For conditions of admission see page 289.

MARCH 16.—"The Compound Air-Engine." By Col. F. BEAUMONT, R.E.

MARCH 23.—"The Increasing Number of Deaths from Explosions, with an Examination of the Causes." By CORNELIUS WALFORD.

MARCH 30.—"Recent Advances in Electric Lighting." By W. H. PREECE.

APRIL 6.—"The Discrimination and Artistic Use of Precious Stones." By Professor A. H. CHURCH, F.C.S.

APRIL 27.—"Five Years' Experience of the Working of the Trade Marks' Registration Acts." By EDMUND JOHNSON.

Dates not yet fixed:—

"The Manufacture of Glass for Decorative Purposes." By H. J. POWELL (Whitefriars Glass Works).

"Buying and Selling; its Nature and its Tools." By Professor BONAMY PRICE, M.A. Lord ALFRED S. CHURCHILL will preside.

"The Electrical Railway, and the Transmission of Power by Electricity." By Alexander Siemens.

Foreign and Colonial Section.

Tuesday evenings, at eight o'clock:—

March 15.—"Diamond Fields of South Africa." By R. W. Murray.

April 5.—"Trade Relations between Great Britain and her Dependencies." By William Westgarth.

Applied Chemistry and Physics Section.

Thursday evenings, at eight o'clock:—

March 24.—"The Future Development of Electrical Appliances." By Prof. John Perry.

The meeting previously announced for April 7 will be held on May 12.

Indian Section.

Friday evenings, at eight o'clock:—

March 4.—"The Results of British Rule in India." By J. M. Maclean. Sir Richard Temple, Bart., G.C.S.I., C.I.E., D.C.L., will preside.

March 25.—"The Tenure and Cultivation of Land in India." By Sir George Campbell, K.C.S.I., M.P.

May 13.—"Burmah." By General Sir Arthur Phayre, G.C.M.G., K.C.S.I., C.B.

Members are requested to notice that it may be necessary to make alterations in the dates of the above papers.

Cantor Lectures.

Monday evenings, at eight o'clock:—

The Third Course will be on "The Scientific Principles involved in Electric Lighting," by Prof. W. G. Adams, F.R.S. Four Lectures.

Syllabus of the Course.

Lecture I.—March 7.

The production and regulation of electric currents. The laws of the mutual induction of currents and magnets.

Lecture II.—March 14.

The measurement of electric currents. Efficiency of magneto- and dynamo-electric machines. Heating effects of the current.

Lecture III.—March 21.

Use of magneto- and dynamo-electric machines for electric lighting. Electric lighting by means of the arc.

Lecture IV.—March 28.

Subdivisions of the electric current. Incandescent lamps. Luminous effects of electric currents in a vacuum, and in various gases.

The Fourth Course will be on "The Art of Lace-making," by Alan S. Cole. Three Lectures.

April 25; May 2, 9.

The Fifth Course will be on "Colour Blindness and its Influence upon Various Industries," by R. Brudenell Carter, F.R.C.S. Three Lectures.

May 16, 23, 30.

MEETINGS FOR THE ENSUING WEEK.

Monday, March 7th...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Professor W. G. Adams, "The Scientific Principles Involved in Electric Lighting." (Lecture I.)
Farmers' Club, Inns of Court Hotel, Holborn, W.C., 4 p.m. Mr. T. Aveling, "Tithes, Ordinary and Extra-ordinary."
Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.
Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. H. H. Collins, "Sanitation as an important increment of value in House-Property."
Society of Engineers, 6, Westminster-chambers, 7½ p.m.
Medical, 11, Chandos-street, W., 8½ p.m.
Victoria Institute, 7, Adelphi-terrace, W.C., 8 p.m. Mr. R. Brown, "Language and the Theories of its Origin."
London Institution, Finsbury-circus, E.C., 5 Prof. A. H. Sayce, "The Gods of Canaan."

Tuesday, March 8th...Medical, 11, Chandos-street, Anniversary.
Royal Institution, Albemarle-street, W., 3 E. A. Schäfer, "The Blood." (Lecture VI
Central Chamber of Agriculture (at the Ho Society of Arts), 11 a.m.
Medical and Chirurgical, 53, Berners-stre street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, W S.W., 8 p.m. 1. Discussion on Sir William paper, "Tide-Gauge, Tidal Harmonic An Tide-Predicter."
Photographic, 5A, Pall-mall East, S.W., 8 by Mr. Payne Jennings.
Anthropological Institute, 4, St. Martin's-p 8 p.m. 1. Exhibition of rubbings taken posts and window-frames in New Zealan note from Prof. Max Müller. 2. Mr. "Note on Assam Dwellings." 3. Major thorpe, "A short account of the Wild Tribe the so-called Naga Hills, on our North-East of India."
Royal Horticultural, South Kensington, S.W.

Wednesday, March 9th...**SOCIETY OF ARTS** (in of the South Kensington Museum), 8 p.m. Whymper, "Ascents of Chimborazo and 1880."
Geological, Burlington-house, W., 8 p.m. Owen, "Description of Parts of the Ske Anomodont Reptile (*Platypodosaurus rob* Part 2. The Pelvis." 2. Prof. R. Owen, " *Theriodontia*, with a Description of a New Species (*Ælurosaurus felinus*, Ow.)." 3. Dawson, "Additional Observations on the Geology of British Columbia and Adjacent
Graphic, University College, W.C., 8 p.m.
Microscopical, King's College, W.C., 8 p.m. Michael, "A Species of Acarus Believed recorded."
Royal Literary Fund, 10, John-street, Ade 3 p.m. Annual Meeting.
Sanitary Institute of Great Britain, 9, Condui 8 p.m. Adjourned Discussion upon Mr. W. paper, "The Law in Relation to Sanitary P
Royal United Service Institution, Whitehall-y Lieut.-Col. E. F. Chapman, "The March to Kandahar in August, 1879, and the Batt September."

Thursday, March 10th...Royal, Burlington-house, W
Antiquaries, Burlington-house, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., W. Morris, "The Prospects of Architectu Civilisation."
Society for the Encouragement of Fine Arts street, W., 8 p.m. Mr. Walter J. Allen, reference to the Stage." The Sequel.
Royal Institution, Albemarle-street, W., 3 p. Houghton, "The Picture Origin of the Characters." (Lecture II.)
Inventors' Institute, 4, St. Martin's-place, W
Royal Society Club, Willis's-rooms, St. Ja 6 p.m.
Mathematical, 22, Albemarle-street, W., 8 p.

Friday, March 11th...Royal United Service Institu hall-yard, 3 p.m. Vice-Admiral W. M. Do Tactics."
Royal Institution, Albemarle-street, W., 9 p. Stuart Blackie, "The Language and Liter Scottish Highlands."
Astronomical, Burlington-house, W., 8 p.m.
Geologists' Association, University College, Visit to the British Museum, under the dir Stuart V. Ridley.
Quekett Microscopical Club, University Co 8 p.m.
Clinical, 53, Berners-street W., 8½ p.m.
New Shakespeare, University College, W.C., Brinsley Nicholson, "The 'Tempest' fo older Play." 9. Mr. Herbert A. Evans, " of 1 and 2 'Henry IV.'"
Royal College of Physicians, Pall-mall East, (Gulstonian Lecture.) Dr. Coupland, (Lecture I.)
Folk Lore Society, 22, Albemarle-street, W., J. Sibree, jun., "The Oratory, Songs, Folk Tales of the Malagasy."

Saturday, March 12th...Ladies' Sanitary Associ House of the Society of Arts), 5½ p.m Richardson, "Domestic Sanitation or Heal (Lecture V.)
Physical, Science Schools, South Kensington. Col. Festing and Capt. Abney, "The Absor of Organic Bodies."
Royal Botanic, Inner-circle, Regent's-park,
Royal Institution, Albemarle-street, W., 3 Stuart Poole, "Ancient Egypt in its Comp tions." (Lecture IV.)

AL OF THE SOCIETY OF ARTS.

No. 1,477. VOL. XXIX.

FRIDAY, MARCH 11, 1881.

ications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

CANTOR LECTURES.

rst lecture of the third course was delivered lay, 7th inst., by Professor W. G. Adams, on "The Scientific Principles involved in Lighting." The lecturer commenced description of the production and regula-lectric currents, and then illustrated the the mutual induction of currents and . Arrangements have been made for the n of various incandescent and other lamps at the third and fourth lectures, and for pose the British Electric Light Company dly promised to lend Gramme machines, rs. Robey to lend a steam-engine to drive ines.

ctures will be published during the summer

ALBERT MEDAL.

ouncil will proceed to consider the award lbert Medal for 1881, early in May next. al was struck to reward "distinguished promoting Arts, Manufactures, or Com-and has been awarded as follows :—

, to Sir Rowland Hill, K.C.B., F.R.S., "for service to Arts, Manufactures, and Com-the creation of the penny postage, and for reforms in the postal system of this country, ts of which have, however, not been confined untry, but have extended over the civilised

, to his Imperial Majesty, Napoleon III., "for hed merit in promoting, in many ways, by his xertions, the international progress of Arts, ures, and Commerce, the proofs of which are y his judicious patronage of Art, his enlight-nercial policy, and especially, by the abolition ts in favour of British subjects."

, to Professor Faraday, D.C.L., F.R.S., for ies in electricity, magnetism, and chemistry, their relation to the industries of the world, argely promoted Arts, Manufactures, and ."

, to Mr. (afterwards Sir) W. Fothergill Cooke ssor (afterwards Sir) Charles Wheatstone, in recognition of their joint labours in estab-first electric telegraph."

, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For. Memb. R.S., Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. (now Sir) Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. (now Sir) Henry Bessemer, F.R.S., "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Michel Eugène Chevreul, For. Memb. R.S., "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

In 1873, to C. W. Siemens, D.C.L., F.R.S., "for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvement in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to the Manufactures and the Arts."

In 1875, to Michel Chevalier, "the distinguished French statesman, who, by his writings and persistent exertions, extending over many years, has rendered essential service in promoting Arts, Manufactures, and Commerce."

In 1876, to Sir George B. Airy, K.C.B, F.R.S., Astronomer Royal, "for eminent services rendered to Commerce by his researches in nautical astronomy, and in magnetism, and by his improvements in the application of the mariner's compass to the navigation of iron ships."

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., member of the Institute of France, "the distinguished chemist, whose researches have exercised a very material influence on the advancement of the Industrial Arts."

In 1878, to Sir Wm. G. Armstrong, C.B., D.C.L., F.R.S., "because of his distinction as an engineer and as a scientific man, and because by the development of the transmission of power—hydraulically—due to his constant efforts, extending over many years, the manufactures of this country have been greatly aided, and mechanical power beneficially substituted for most laborious and injurious manual labour."

In 1879, to Sir William Thomson, LL.D., D.C.L., F.R.S., "on account of the signal services rendered to Arts, Manufactures, and Commerce by his electrical researches, especially with reference to the transmission of telegraphic messages over ocean cables."

In 1880, to James Prescott Joule, LL.D., D.C.L., "for having established, after most laborious research, the true relation between heat, electricity, and mechanical work, thus affording to the engineer a sure guide in the application of science and industrial pursuits."

The Council invite members of the Society to forward to the Secretary, on or before the 23rd of April, the names of such men of high distinction as they may think worthy of this honour.

COMMITTEE ON PREVENTION OF STREET ACCIDENTS.

A meeting of the Committee appointed by the Council to confer with a deputation from the Society for Preventing Street Accidents, was held on Monday, March 7, at the House of the Society of Arts. Present:—Sir Rutherford Alcock, K.C.B., Mr. G. C. T. Bartley, Mr. Andrew Cassels, and Sir Henry Cole, K.C.B., with Mr. H. Trueman Wood, Secretary, on the part of the Society of Arts; Viscount Templetown, Sir Hastings Doyle, Dr. D. H. Goodsall, Mr. W. R. Philp, the Rev. William Rogers, Mr. W. E. Stevenson, and Mr. E. C. Keevil, Secretary, on the part of the Society for Preventing Street Accidents. It was resolved to recommend the Council to appoint a deputation to wait upon the Lord Mayor.

PROCEEDINGS OF THE SOCIETY.

APPLIED CHEMISTRY AND PHYSICS SECTION.

Thursday, February 24, 1881; Captain Sir George Nares, R.N., K.C.B., F.R.S., in the chair.

The paper read was—

DEEP-SEA INVESTIGATION, AND THE APPARATUS EMPLOYED IN IT.

By J. Y. Buchanan, F.R.S.E., F.C.S.

Deep-sea investigation, in the sense of exploring the surface of the ocean with the view of discovering new lands, and so determining the boundaries of the sea, has, in all ages, commanded the attention of the more civilised races of mankind, and the most adventurous of their members have ever engaged with enthusiasm in its pursuit. It is probable that the first voyages were undertaken, less with a view to satisfy curiosity, than to render travelling from place to place more expeditious and less irksome. It was not until the mariner's compass had been introduced into Europe, in the 12th century, that long voyages, out of sight of land, could be undertaken; although the enterprise of the Mediterranean mariners enabled them to take their ships as far as Britain without any such aid; and no one who is at all acquainted with practical navigation, will deny the difficulty and the danger of the undertaking. The adoption of the compass as a standard of direction, and the immense amount of valuable property which was consequently risked on the faith of its infallibility, raised a strong interest in the study of the behaviour of the magnetic needle in different localities, especially at sea, resulting in the discovery and investigation of the magnetic ...ich consequently, became a recog-

nised phenomenon to be tak... all questions affecting a ship's ... his voyage, which ended i... America, Columbus crossed ... position of a line of "no ... what west of the Azores. ... Papal decree, made the bound... kingdoms of Portugal and ... the determination of its pos... factitious importance which w... of much valuable geographi... first voyages for scientific purp... taken for determining the m... different places on the ocea... subject to continual variations ... tion from time to time is lik... future a motive for frequent n...

It was in connection with ... magnetic phenomena that a ... venient method of graphical ... relation between isolated ob... its first extension. In an or... one of the principal feature... This line represents the most ... the intersection of the sea s... surface, as deduced from obs... points. With greater detail ... height of points inland abo... mined, from which profiles a... of equal height on these pr... and their projections on the se... in the map as lines of equal h... generally called contour line... of the land below the sea is ... method of graphic represent... a chart, however, all the or... of depth are entered, while i... configuration of the count... deduced from the individua... larly, in rendering the re... magnetic observer conven... accessible to the public, ... navigator, the results of ... variation at the different ... in a chart, and points of e... nected by lines drawn at ... from degree to degree, or ... the case of sea and land ... sea the magnetic consta... nowhere abruptly, conseq... contours of moderately r... wants of navigation. ... on land, especially in v... consisting largely of ig... constant constituent of ... oxide of iron or loadst... which it is present in ... to one another, often va... The consequence is, th... ferent directions at loc... that a survey of such ... materially, according a... on solar or magnetic ...

The employment o... the results first of geo... servations, was ext... representation of ter... have since been larg... tribution of other q... water, and of plant...

it, however, as is the investigation of heonomena at sea, it is not my inten- r further to it to-night; it is enough to ited out that the interest which it for navigation was the moving cause ing out of the earliest maritime scien- litions. Our concern is with the deter- of the depth of the ocean, of the dis- of temperature in its waters, of the nd physical character of its waters, and ound at its bottom, and with the dis- of life in it.

t problem of deep-sea investigation is to the extent of the ocean, its size, its The superficial extent and limits are de- by the surveyor. In order to map out n of the sea, there is only one method, he direct determination of the depth at laces as possible.

ship is "in soundings," the depth is d at frequent intervals by a "leadsman" in some convenient place on the outside p, whence he can throw forward the lead to the line which he carries in his hand. ary hand lead line is from 20 to 25 ng, and it is conventionally marked with ather at 2, 3, and 10 fathoms, white 5 and 15, red bunting at 7 and 17, blue 13, and with two knots at 20 fathoms. is a long, finely-tapered block, of 14 lbs. weight; it has a recess at the and is perforated at the other end for ion of the line. This instrument is l while the ship is in motion. The man ith the duty swings the lead backwards rds, and even completely round a rcle, in order to generate the re- mentum to carry the lead well in the ship before it touches the water. It rapidly, whilst the leadsman's position g to the spot where the lead touched When the line has thus been brought n, the depth is ascertained by observa- marks on the line. It is obvious that by ive, but effective, method of sounding, g depth which can be so ascertained efly on the speed of the vessel, and in ee on the skill and strength of the Under ordinary circumstances, the ffective in depths up to twelve or fifteen d this degree of efficiency suffices for ses.

lly, however, it is advisable to sound depths, without the ship being neces- mary. The simplest method of doing uce as much as possible the ship's way, carried the line well forward, to leave d give it line as it sinks. Here the he speed of the vessel should be so pro- that the lead reaches the bottom before s passed completely over it. With care, te soundings can be obtained in this e depth must not be much above thirty homs.

e object is to sound in ocean water, ust be prepared to meet with depths of e thousand fathoms, it is essential that e kept stationary, and if hemp line be heavier weights must be employed. n great depths is one of the most important operations connected with deep-sea investigations, and it is only within the last thirty years that it has received any very great attention. Probably the first attempt at deep-sea sounding was made by Captain Constantine John Phipps, during his Arctic voyage, in the year 1773, when he was accompanied by Dr. Irving, who made a number of very valuable determinations of the temperature of the sea water at different depths, besides fitting the vessel with one of the earliest stills, which worked well, and supplied the crew with fresh water during the whole cruise. Phipps' deepest sounding appears to have been 683 fathoms. For this purpose, all the lead line in the ship was used, and a lead weighing 150 lbs., which appeared to have sunk about ten feet into the mud, a soft blue clay. With this was sent down a water-bottle, of Dr. Irving's construction, and the water brought up had a pressure of 40° Fahr., that of the surface being 55° Fahr. The density of the water was also measured, and Cavendish's self-registering thermometers were used. So that, at this early date, the methods and objects of deep-sea investigations were perfectly understood. What prevented much work being done was chiefly the want of steam. But little advance was made in this branch of research until after the termination of the French war. In 1818, Captain John Ross made his well-known voyage of discovery to the Arctic seas, in H.M. ss. *Isabella* and *Alexander*. During this voyage, he paid great attention to deep-sea investigation, and invented, and had constructed, one of the earliest satisfactory instruments for bringing up a considerable quantity of the bottom-mud in deep water. He, himself, gives the following account of his instrument and its performances, in the appendix to the account of the voyage:—

"This instrument was invented by me, on board his Majesty's ship *Isabella*, in the early part of our voyage to the Arctic Regions. Many fruitless attempts had been made to procure substances from the bottom of the sea in deep water, by the instruments with which we were supplied, and I had an opportunity of observing the reasons of this failure, which led to the discovery of that which I am about to describe, and which, in almost every instance, completely succeeded in accomplishing that desirable object, of bringing up substances of any description, in considerable quantity, from any depth; but it has also been found to preserve the temperature of any substances, if they are soft, until it can be measured by the thermometer, and by that means the temperature of the earth can be nearly ascertained at any fathomable depth. In Melville Bay, on the 1st of August, it brought up from four hundred and twenty fathoms some soft mud, into which the thermometer was immediately immersed, and it gave 29½°. At the same time, the self-registering thermometer, at the depth of two hundred and ten fathoms, gave the same temperature. In Prince Regent's Bay, in four hundred and fifty-five fathoms, it gave the same temperature. In the entrance of Lancaster Sound, at the depth of six hundred and seventy-four fathoms, the temperature of the mud was also found to be 29½°; and at the highest part of that inlet in which we sounded, the mud was found to be, in six hundred and fifty fathoms, 29°.

"On the 6th of September, in latitude 72° 23′ N., and longitude 73° 07½ W., we sounded in 1,050 fathoms, from which depth the instrument brought up 6 lbs. of very soft mud. The next day being quite calm, we tried the temperature of the sea at five, six,

seven, eight hundred, and a thousand fathoms, and found its temperature decrease, from 35 gradually to the same temperature as the instrument gave it, which was 28½. Although the instrument may not bring up the mud at the exact temperature of that at the bottom, it may be supposed that it cannot have suffered much alteration, from its agreeing so nearly with the self-registering thermometer, and that, if it has altered, it must be to increase the degree of temperature; hence, it may always be inferred that the mud at the bottom is not of a higher temperature than that brought up by the instrument. The reasons for so little alteration taking place is the closeness with which the instrument confines the mud, which is such as not to allow even the water to escape. If the instrument strikes among stones which are small enough to get between the forceps, it will bring up as many as are enclosed in them; in one instance, it brought up a stone (which weighed two pounds and a half) from 300 fathoms, and, in another, it struck a rock, and cut a piece out, which it brought up from 216 fathoms. The instrument was made from the model by the ship's armourer, and succeeded on the first trial.

"To use the deep-sea clamms, it is necessary to be provided with whale lines, such as are used by the Greenland and South Sea ships, which are two and a half inches in circumference, made of the best hemp, and very pliable and easily coiled; the lines ought to be spliced together, and faked, or coiled, so as to run quite clear on the fore part of the ship's decks. In very deep water it is necessary that it should be calm, or nearly so, to be certain that soundings are obtained in 500 fathoms; but, in a light breeze, the instrument may be hung to a boat, and towed in the direction of the ship's drift, and if there is any wind, it is best to lower all the sails down. An outrigger, fitted with a block, should be fixed in the weather-quarter, through which the line ought to be rove and bent to the instrument, when it ought to be lowered until it is a fathom below the surface, and then let go. The instruments and lines may, however, be made for different depths, and used accordingly. For the North Sea, I would recommend one of fifty pounds."

The cast-iron sinker of the one actually used by Captain Ross was a long, hollow, parallelopiped, weighing one hundredweight.

About the same time as Sir John Ross was prosecuting his voyages on behalf of the Government, Scoresby, in the pursuit of his trade as a whaler, was collecting most valuable information. Of all the navigators who have combined with the due discharge of their duties as sailors the scientific investigation of the conditions of the ocean, the younger Scoresby is certainly the one most imbued with the spirit of the philosopher. The problems to be solved seem to present themselves at once to his mind divested of all irrelevant matter, and he attacks them directly and successfully. In sounding at great depths, for instance, he at once recognises that when the ordinary deep sea line and lead are used, the increasing weight of line, in proportion as more of it is required, renders less certain the determination of the moment when bottom is reached. He determines the density of the water with a thermometer with large bulb and narrow stem, and he gives a table for correcting observed specific gravities for temperature, which shows that he knew that sea water did not attain a maximum of density at the same temperature as distilled water. The following passage from his "Arctic Voyage" will show how thoroughly he knew the nature of the work which he had taken up:—

"The difficulty of getting satisfactory
great depths, arises principally from th
intimation given when the lead strikes
This uncertainty is increased by using a thi
if a lead of a hundred pounds were use
attached to it would require to be so thick
depth of six or eight hundred fathoms, th
the line, even in water, would be so many t
than that of the lead, that scarcely any eff
observed when it should reach the bottom
always prefer a light lead, and a very small
a lead of 20 pounds, I have sounded in
fathoms, and felt assured that if it had
bottom I should have observed it, for the
line in use was not above twice as heavy
so that the diminution of one-third of the w
have been very observable. But with a he
thick line, where the strength of several me
to haul it up, there can be no evidence, wit
of weighing, of any trifling alteration in t
weight. Hence, if the lead is found to hav
bottom, there can be no assurance that a qu
line, as well as the lead, has not also been on
To a 20 lb. or 28 lb. lead, I generally attac
fathoms of common log-line, where there is
apparatus along with it, and to this a sma
and finish with a deep-sea line, thus increa
in thickness with the increase of weight to b
and having the whole of such a weight t
can be held in the hand, and the least sto
perceptible."

After showing how, from observat
whale fishing, he had often been ab
correct conclusions as to the depths of w
the amount of line which they woul
when running perpendicularly down
relates the following story, from the l
his father, who was also a whaler:—

"At great depths, the effect of the pr
sea is not a little curious. My father m
following singular instance, in the year 17
have taken from his log-book. On the 3
the chief mate of the *Henrietta*, of Whitby,
father then commanded, struck a whale,
all the lines out of the boat before assist
and then dragged the boat under water, the
while escaping to a piece of ice. When the
to the surface to 'blow,' it was struck a
and soon afterwards killed. The moment i
began to sink, which, not being a usual ci
excited some surprise. My father, who
assisting at the capture, observing the ci
seized a grapnel, fastened a rope to it, threw
tail of the fish, and fortunately hooked it.
to sink, but the line being held fast in
length stopped it, though not until t
was such that the boat was in danger
The 'bight' or loop of a rope being
round the fish, and allowed to drop
inclosed the line belonging to the
which was found to be the cause of the
observed. Immediately the harpoon slippe
whale, and was, with the line and boat at
on the point of being lost, when it was lu
by the encompassing rope. The fish being
from the weight of the line and boat, rose
face; and the strain was transferred to th
nected with the disengaged harpoon.
imagining that the sunken boat was entan
rocks at the bottom of the sea, and that the
current on the line produced the extraord
proceeded himself to assist in hauling u
The strain upon the line he estimated at
three fourths of a ton, the utmost power of
men being requisite to overcome the w

laborious operation of hauling the line in occupied several hours, the weight continuing nearly the same throughout. The sunken boat, which before the accident would have been buoyant when full of water, when it came to the surface required a boat at each end to keep it from sinking. When it was hoisted into the ship, the paint came off the wood in large sheets, and the planks, which were of wainscot, were as completely soaked in every pore as if they had lain at the bottom of the sea since the Flood. A wooden apparatus that accompanied the boat in its progress through the deep, consisting chiefly of a piece of thick deal, about fifteen inches square, happened to fall overboard, and though it originally consisted of the lightest fir, sunk in the water like a stone. The boat was rendered useless; even the wood of which it was built, on being offered to the cook as fuel, was tried, and rejected as incombustible."

The incident is exceedingly interesting, as being, perhaps, the first occasion on which the effect of the enormous pressure produced by a column of water was directly observed. It will be observed that the wood, though painted, got completely water-logged, while the whale, which must have penetrated to nearly the same depths, retained its buoyancy.

The plan introduced by the Americans, of using the twine and a heavy weight, sacrificing both at every sounding, was one which, with a little elaboration, could have been made to give very accurate measurements of depth. And, indeed, when it was found that ordinary observation or feeling did not suffice to indicate when the shot had reached the bottom, the practice of observing the rate at which successive equal lengths of the line passed out, which has since been so useful, was introduced. It is worthy of remark that, at this early date (about 1850), iron wire was used instead of twine, by Lieutenant Walsh, of the U.S. schooner *Taney*.

When telegraphic enterprise began to develop itself, deep-sea sounding became of great practical importance, and, since the date of the first Atlantic cable, it has been carried on both by Governments and commercial companies, with all the energy induced by prospective money-making. For the telegraphic engineer, however, it was not enough to know the depth of the water; it was of almost equal importance for him to know the nature of the ground on which his cable was to lie. The invention, in 1854, by passed Midshipman Brooke, of the U.S. Navy, of a contrivance to detach the weight used to carry down the sounding-line, while it enabled a specimen of the bottom to be brought up, was of great importance in rendering easier and more accurate the survey of the ocean bed. Brooke's sounding apparatus consisted of a cannon-ball, with a hole drilled through it. Through this hole passed a straight rod, fitted at its upper end with peculiar disengaging hooks. The weight was slung to these hooks by means of a wire, which passed from a ring, which was slipped over the rod under the weight, up on each side of the cannon-ball to the hooks. The sounding-line was attached to eyes in these hooks, and as long as the lower end of this rod was not resting on any thing, the weight was kept securely in its place, and available for taking out the sounding-line. As soon, however, as bottom was reached, and this rod came to be supported on its lower end, the hooks at the upper end fell forward, and allowed the wire to disengage itself. The weight was thus released, and, on the line being pulled up, the rod came away through the perforation of the shot, and brought with it specimens of the mud in small quill tubes fitted in a recess in the lower end of the rod. The principal object which Brooke had in view was to disengage his weight, and his contrivance for doing so is excellent, the moment the end of the rod touches bottom, the weight slips off. In order, however, to gain the greatest possible amount of information from a deep-sea sounding, it is advisable to arrange so that the tube, which is now used in similar machines instead of a rod, should penetrate the ground as far as possible. This is attained by so arranging the apparatus that the weight does not detach at the moment of striking bottom, but only when hauling in is begun. This condition is fulfilled in the instrument used in H.M.S. *Bulldog*, by Sir Leopold M'Clintock, in the year 1860. It is a modification of Sir John Ross's "deep-sea clamm," in which the weight presses the clamm into the ground, until, on pulling in the line, it is thrown off and left at the bottom. This instrument brings up a specimen of what is at the surface of the ground, but does not give a sample of what is below.

The "Fitzgerald" sounding machine was used in the expedition in H.M.S. *Lightning*, in the summer of 1868, when it gave satisfaction. It was tried on board the U.S.S. *Tuscarora*, and Commodore Belknap reports unfavourably of it. From its irregular form, it offers considerable resistance during descent, and in coming up gets the line full of kinks.

At the latter end of 1868, Captain Shortland was ordered to make soundings between Bombay and Aden, and for this purpose he devised and constructed on board his ship, the *Hydra*, a modification of Brooke's apparatus, which gave great satisfaction, and was afterwards used in the *Porcupine* and the *Challenger*. The general arrangement is the same as in Brooke's apparatus; instead, however, of a rod, he has a brass tube, which passes through the centre of the weight, which consists of one or more cylinders of cast-iron. These weights are slung by a wire to a shallow hook, on the upper part of the rod, which surrounds the brass tube. The lower end of the brass tube carries a pair of butterfly valves, and in the middle of the tube are two conical valves opening upwards, between which a sample of the bottom water is secured, while a specimen of the mud is brought up in the lower segment of the tube. In later instruments, the tube was adapted only for the reception of the mud. When this instrument was used, the tube penetrated into the ground until the weights were supported on the bottom, when a steel spring at the upper end of the rod expanded, and threw the bight of the wire off the hook. The weights were thus released, and on hauling in the line, the tube alone was brought up. During the first year of the cruise of the *Challenger*, this instrument was exclusively used, and it gave general satisfaction. The principal objection to it lay in the smallness of the samples of bottom which it brought up. This was due first to the narrowness of the tube, and also to the butterfly valves at the end. The object of these valves is to keep the samples from being washed out, but they also very materially obstruct the

entrances. With a much larger tube, and a rightly ground valve at the top, better samples would have been obtained.

After the first year of the cruise, the "Hydra" machine was replaced by the "Bailey." This was an apparatus very much on the same lines, but differing from the "Hydra," in the size of tube, and the method of disengaging. The tube, which was of iron, was 5 feet long by 2½ inches wide, and weighed alone 25 lbs. The hook which carried the wire and weights formed part of a separate brass piece, which telescoped into the iron tube the moment it touched bottom, thus throwing off the weights without utilising them for pressing the tube further into the mud. The weight, however, of the tube alone was so considerable, that this was of little matter, and the "Bailey" usually brought up large samples of mud. It must, however, be remembered, that though the samples were large in quantity, they were principally from the superficial layer. In working with a tube of 2½ inches internal diameter, a substantial valve of some sort is necessary to prevent the samples falling out when the tube is being brought on board. Such a valve is always a great impediment to the entrance of the mud. It would, therefore, be of great importance to arrange the Bailey tube, so that the weight should be utilised in shoving it into the ground, and also that a greater length of it should protrude beyond the weight. In this way, samples of the mud below the superficial layer would be obtained, and the interest attaching to it is evident. Even with the "Bailey," as it is, we find in several places a red clay at the surface, with white mud below it.

In exploring the seas and lakes of the Highlands of Scotland, I have made extensive use of a form of sounding tube and lead, which I devised for the purpose, and which I have always found to act very well. Its construction is simple, being in effect nothing but a straight brass tube, of one inch diameter, carrying a brass shoulder about one foot from the lower end. A cylindrical leaden sinker of suitable weight is slipped over the upper end, and rests on the shoulder. This line is made fast to a metal eye at the top, and the part of the tube below the shoulder can be unscrewed, and the mud which has been brought up in it squeezed out by a plunger. I have tubes of various lengths, with sinkers of various weights, for work at different depths, and under different conditions. For work in inland lakes it is necessary that every thing should be as light as possible, in order to be suitable for land transport. I use a tube and sinker, weighing in all three pounds; while at sea, with the steam winch available, the sinker weighs generally 28 lbs. Where the bottom is soft mud, these tubes bury themselves in it, and bring up very considerable samples. The samples are also very satisfactory when the bottom is clay; when, however, the bottom is hard sand, or similarly resisting material, the tube impinges suddenly on it, and does not penetrate as deeply as might be wished. The effect is very much as if an attempt were to be made to make a spade penetrate the ground by a sudden blow, instead of a persistent shove. I have designed an arrangement which will enable the tube to exercise a gradual pressure on the bottom, and so to penetrate muds or sands, which offer considerable resistance. Instead of the weight resting on a metal shoulder, ri[g] attached to the tube, I suspend it by strong i[n] rubber cords, from hooks near the top of the When the tube strikes the bottom, the w[eight] delivers its blow gradually through the stret[ch] of the india-rubber. I have had a tube o[f this] kind constructed five feet long, and with a[valve] at the top. This valve at the top is t[o pre]vent the contents of the tube falling [out by] their own weight, when the apparatus h[as been] taken out of the water, and is being brou[ght on] board. These tubes bring up samples o[f] very coarse sand, and Captain Tizard, wh[o used] one last year in the surveying vessel *Errant*, found that in *globigerina* ooze it was [washed] out on the way out. I feel sure that, w[ith] india-rubber slings, the tube would p[ass] through the layer of comparatively [coarse] *foraminifera* on the surface, and plug its[elf] bottom with the more finely comminu[ted] clayey substance which is usually foun[d]. Where the object is to make soundings ra[pidly] and to get a small sample of the mud on th[e sur]face of the bottom (as in sounding for teleg[raph] cables), a lead with a blunt end is used. [It] penetrates only a small way into the mud, an[d is] easily drawn out, bringing a sufficient sampl[e in] the axial tube. Mr. Gray, of the Silverto[wn] Telegraph Works Company, showed me [the] sinkers used on board their ships. They weig[h] thirty pounds, and at the bottom of the tube is [a] very simple and ingenious valve, made of indi[a-] rubber, which is pressed against the side of th[e] tube by the lead, while sinking, and expand[s] and closes the orifice sufficiently to prevent th[e] sample being washed out on coming up.

I now proceed to consider the precautions [to] be observed in the actual use of these instrumen[ts].

On stopping the ship, "to make a station," t[he] first operation is to determine the depth. For th[is] purpose the ship, under steam, is brought head, [or] in some cases stern, to wind, and kept as nearly [as] possible stationary while the sounding is bei[ng] effected. The method of sounding in deep wa[ter] is essentially the same whether hemp-line or w[ire] is used. In both cases, it is necessary to l[oad] the end of the line with such a weight th[at] in the deepest water which may reasonably [be] expected, the velocity of descent shall not [be] diminished to an excessive extent by the frict[ion] of the increasing length of line in pass[ing] through the water. Twenty years before [the] *Challenger* sailed, wire had been used on isola[ted] occasions by the Americans, but it was not u[ntil] Sir William Thomson took it up, and, w[ith] characteristic energy, worked it out into a pract[ical] method, that it became really available. W[hen] the *Challenger* fitted out, it was decided, an[d I] think, wisely decided, to use hemp-line, which [had] already yielded valuable results, and the work[ing] of which, even at the greatest depths, was fami[liar] to her captain and officers. During the three [and] a-half years of her expedition, the extension [of] telegraphic enterprise rendered rapid deep-sounding a necessity, and, in consequence, [de]veloped both the apparatus and the art. Now[a]days, our sailors are almost as familiar w[ith] the handling of wire as with that of rope, [and] no similar expedition would now start wi[th]out being furnished with apparatus for us[ing]

deep sounding. At the same time, it be equally improper to start without cient supply of good hemp line, and the tus for working it. For we should never our affection for what is novel to blind us advantages of what is older-fashioned. For purposes wire must supersede hemp, because the work better and more expeditiously, are are other departments of the work of sa investigation which are better done with The great advantage of wire above hemp is or the same tensile strength, we have a line passes through the water without developing serious retarding force due to friction, as, with hemp line, the retardation so pro is very great. The saving in time and due to the absence of this frictional resistance, is so great that there can be no question se between wire and hemp when it is re to sound in deep ocean water. To take an le, in water of 1,500 fathoms, a three-dweight sinker, with the best hemp sound-, takes twenty minutes to reach the bottom; ire, and a thirty-pound sinker, the sounding leted in from twenty-five to thirty minutes. ugh, however, it is thus incomparably to hemp for deep sounding, it has disges from which the hemp is free. Its drawback springs from its liability to A hemp line may be bent and twisted in we please, without its strength being in affected; not so, however, with wire. ts whole lifetime it must never suffer a nd, or twist, or nick; if it does, its s gone, and if the damaged part is not accident is sure to happen. Again, Sir homson has always advocated the use of l wire, which rusts easily when moistened water. In order to preserve it, the wire, h the reel, has to be kept in a tank of dered alkaline with soda or lime. This nvenience; but my own experience leads conclusion that there is no reason why steel wire should not be used, and I it keeps perfectly well without any re. The objection usually raised to l wire is, that the process of galvanisens it. This difficulty I got over by o. 20 galvanised instead of No. 22 recommended by Sir William Thomson. am power is not available for heaving re possesses a very great advantage, for it ily worked, even at very great depths, The U.S. ship *Tuscarora*, which, in 1874, ut the route from San Francisco to Japan, ing so, surveyed the deepest water in the l all her sounding by hand. As an in what can be done, I will quote from Belknap's report, the work done on the January 17th and 18th. Six soundings le, all in water over 4,000 fathoms in rty-two observations of the temperature below the surface and 1,200 fathoms e, and the current was observed at 10, , 100, and 200 fathoms below the surface. he soundings, the depth being 4,356 occupied two hours and twenty-seven the descent occuying fifty-three, and the ninety minutes.

eam power at hand—and without it, it would be folly to attempt deep-sea work—hemp line becomes preferable to wire, where the other branches of deep-sea work are being carried out, such as serial temperature observations, and the collection of water samples from different depths.

Deep-sea thermometers which have been carefully compared with a standard, and which have been used in many soundings, are instruments of very great value, and if lost cannot be replaced by the purchase of new ones. Hence, in making such observations, the conditions which we have chiefly to keep in view is the safety of our thermometers, while, for the completeness of our work, it is important that the temperature should be observed at as many different depths as possible. Now, as the chance of the hemp-breaking is very small when compared with the wire, it is permissible to risk a greater number of thermometers on it than on a thin wire. Therefore, to get the same number of observations with the wire would require the operations of sinking and heaving in to be repeated a greater number of times than with the hemp, and as a thermometer must be allowed a certain time to take the temperature of the water, it will be seen that for such work the wire is in the end no more expeditious than the hemp, and the use of it is attended with considerable risk of the loss of valuable instruments. I am quite convinced, from my own experience, that for all work in depths up to 500 or 600 fathoms, hemp is better for all purposes, because a sinker can be used, which will make it descend nearly as quick as wire, and, with a steam winch, it can be brought up at nearly the same rate.

The wire has, of course, the advantage, that it stows in a much smaller space than ordinary sounding line.

Finally, and to answer the question which is often put to me, whether wire or hemp should be used in a ship's outfit, I would say take both, as they are both useful in their proper places. For determining the depth, use wire; for detail work, with the thermometers and water bottles, use hemp. In this way your sounding will be done expeditiously, and you will not lose your instruments.

With regard to dredging, which forms a very important department of deep-sea investigation, there can be no doubt of the great superiority of wire over hemp rope. The advantage in point of rapidity of work, and of stowage space, is much greater than in the case of sounding. Here, again, we are indebted for a scientific instrument to the enterprise of telegraphic engineers, for if it had not been a necessity for them, it is not likely that we should now have had the very beautiful flexible steel wire hawsers which are to be found in nearly every ship.

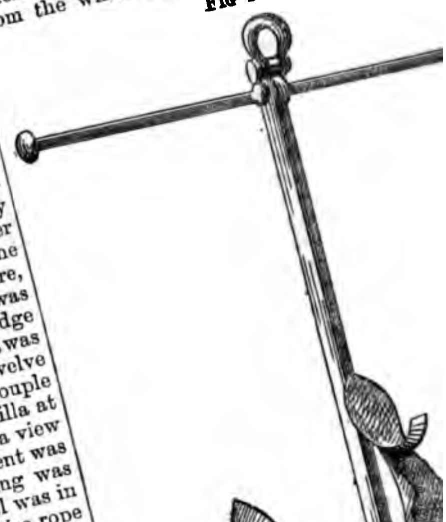
Steel wire rope was first used for deep-sea dredging by Professor Agassiz, in the winter 1877-78, and he has continued to use it with great success. His rope "was one and one-eighth inches in circumference, and was composed of six strands laid round a tarred hemp heart. Each of the six strands was composed of seven galvanised steel wires of No. 19 American (No. 20 Birmingham) gauge. The ultimate strength of the rope was 8,750 lbs.; weight per fathom 1·14 lb. in air, and approximately 1 lb. in sea water; price, eight cents. per foot."

In the summer of 1878, I fitted the steam yacht *Mallard* with a steel wire dredging-rope for work in depths up to 200 fathoms. It consisted of five strands, arranged around a centre of cotton, and each strand consisted of seven steel wires (No. 24 B.W.G.) 0·023 in. in diameter. The diameter of this rope is 0·19 in., and circumference, 0·6 in.; its weight per fathom is 0·33 lb., and breaking strain 10 cwt. It was, unfortunately, not made of galvanised wire, and has now been in use for three seasons without being kept in any kind of preservative; and although necessarily rusty, its worst fault is that, when in use, it is apt to stain the deck.

In deep water, Captain Sigsbee gives the following as safe work:—Time per hundred fathoms, paying out and hauling back, three to five minutes, according to circumstances. He reports a good haul having been made in 800 fathoms in one hour and twenty minutes, including twenty-three minutes for dragging.

My object in furnishing myself with the wire rope was not to dredge, but to be able to anchor in the deepest water to be found on the west coast of Scotland, and thus facilitate the carrying out of physical and chemical observation on the water. In 1877, when I explored a large number of the Scottish lakes and sea lochs, I had found that, in a fresh-water lake, the vertical distribution of temperature is often very different in one place from what it is in another place not many hundred yards distant. The same was also found, though in less degree, in sea-water lakes. It became, therefore, of the utmost importance, in investigating the conditions of temperature in the water, to be sure that the observations were really all made in one and the same place. It is impossible to keep a vessel stationary in one position by means of steam, unless, perhaps, in a land-locked bay, with a breeze blowing sufficiently strong to make the vessel drift faster than her lowest rate of steaming. It became, therefore, of the greatest importance to be able to anchor anywhere, and for this purpose the rope above described was furnished. In the season of 1878, I used a kedge anchor of ordinary form, and weighing 84 lbs. It was attached to the wire rope by means of about twelve fathoms of 2½ inch Manilla rope. Often a couple of furnace bars were strapped on to the Manilla at five and ten fathoms from the anchor, with a view to keep a curve on the line. This arrangement was found to work extremely well. Everything was in prepared before hand, and when the vessel was in position the anchor was let go, and the wire rope allowed to run rapidly off the reel, the strain on the break at the reel being carefully regulated by means of a spring balance, so that the moment the anchor touched the bottom, the reel stopped. The break was then secured at a known strain, such that as the vessel drifted she would take what rope was required. There was thus no paying down of slack line on the top of the anchor. When it was judged that enough rope had been given, the strain on the break was increased, which by gradually bringing the weight of the ship on the anchor, steadied it into the ground. When the anchor was found to be holding, the anchor secured in such a way that, if necessary, it could be cast loose, and the vessel the work could proceed. It is of great importance that the rope should be held fast on board in such a way that it can be easily let go; for, if the anchor begins to drag, then the ship gathers way, and if now the anchor suddenly holds, and it is impossible to veer cable, a very excessive strain is put on the rope in order to stop the ship's way in a very short distance. If, however, the reel can be released, then, by careful working of the break, the anchor can again be steadied into the ground, and the ship stopped without any undue strain being applied to the rope. The rope passes out over the bow of the vessel through a metal block on one of the iron davits used for "catting" the anchor. From this block it is led through another block, which is attached to a spring balance, to the drum of the steam-winch. The angle made by the line between the winch and the outer block is always the same; consequently, the strain shown by the spring balance is always the same fraction of the total strain on the line. This fraction, in our particular case, is as nearly as possible one-third. In heaving up the anchor, it is only necessary to watch the spring balance in order not to over-strain the line. The moment which requires very careful attention is when the anchor is being started out of stiff ground. By careful handling of the winch, the strain is kept steady until the anchor comes away, which is shown by the index of the balance jumping suddenly back when the cable is rapidly wound in. It is taken from the winch by the reel, which is wound up by hand.

FIG 1.



In deep water, th[...] covered by a surface layer of [...] no holding power; it is [...] allow the anchor to sink by [...] this before any great st[...]

he summer of 1878, the anchor used as brought up so many valuable specimens ind, especially of those existing below ce layer, that I determined before the on to provide myself with an anchor uld not only hold the ship, but retain into which it had fixed itself. It is a Trotman's anchor, with an open frame, a solid bar connecting the two palms. ne is laced a stout canvas bag, into which icking to the palm, at the moment of ut of ground, falls (Fig. 1). This has lf a most successful instrument for ex- bottom of the seas, especially where the collect the mud itself, rather than the live on its surface. Also, as an anchor simple it is most efficient, being con- d as an ordinary kedge-anchor.

iomy in stowage, caused by using wire as I have described, will be very appa- consider the amount of it which can on a reel of moderate size. Let the of the core of the reel be 18 inches, and eter of the rope 0·2 inch, then if and tightly wound on such, a reel sixty turns per foot of length. If s of the reel be constructed so that be wound on it until the outside of the coil is 28 inches, then the iameter of one turn of wire rope is and the average circumference one d the number of turns counted in the f a radius would be fifty. We should on a reel 1 foot long by 2 feet 4 inches r, 3,000 fathoms of wire-dredging rope. meter of the checks were made, say, hes, then 3,000 fathoms would be easily ited, even without great care in winding. weight of the line would be 1,000 lbs. iowever, be advisable, if dredging were mpted at such depths, to graduate the line; for it is quite evident that, with ms of it out, the part at the surface of ias to sustain all the strain due to the and the weight of the line, or 9 cwt. s the breaking strain when new is 30 cwt. ere would be an insufficient margin. re often been thrown on the trustworthi- ep soundings, as carried out in the and simplest way, using a hemp-line inker, and keeping the ship as stationary The sources of error most frequently east were, the compressibility of water istence of currents, principally under-

iquid suffers compression, its density is consequently, it was asserted, that at great pressure, the density of water will ual to that of lead, and our sinkers, sinking, will float. Were water com- n the degree that air is compressible, nsity of water might increase at such a make lead float, supposing the lead to ntime uncompressed; but, whereas the air is doubled by raising the pressure it from that of one atmosphere, or of mercury, to that of two atmos- 60 inches of mercury, the density s only increased by one twenty thou- ow, supposing that the compressibility remains the same at high pressures as at low, it would require a pressure of twenty thousand atmospheres to raise the density of water from one to two, and more than two hundred thousand atmo- spheres to raise it to the density of lead. One hundred fathoms of sea water exert a pressure of about eighteen atmospheres; and we may assert, with perfect confidence, that the deepest water in the globe is under five thousand fathoms in depth; therefore, even at the greatest possible depths, the density of the water could not be raised by as much as one-twentieth by pressure alone, and the sinking power of lead, which is itself rendered denser by pressure, could not be appreciably affected. This objection to the validity of deep soundings would not have been worth referring to, were it not that it has been admitted by persons of high authority, and has, by consequence, influenced a large number of persons whose convictions are determined by authority alone. Admiral FitzRoy, for instance, in an appendix to his volume on the voyage of the *Beagle*, says, "The depth to which bodies would sink in an ocean several miles deep has not been proved, and there is reason to think that it is much less than people generally imagine," &c. Scoresby, however, twenty years earlier, with his usual acumen, was able to attach its proper value to objections on this ground. He says:—"In sounding at great depths, where the pressure of the water becomes equal to, perhaps, several hundreds weight on every square inch of surface, some persons have imagined that even lead cannot sink, but will be suspended midway in the sea. I have conversed, indeed, with very intelligent persons, who could not be persuaded that any dependence could be placed on soundings obtained at a depth exceeding 300 fathoms. Were water a compressible substance, like air, it would be possible that, under a certain pressure, it might become as heavy as lead, so that lead, or any other ponderous body, could only sink to a certain depth; but water being incompressible, or nearly so, it is clear, however great the pressure may be, that it must be the same downward as upward, on any body suspended; consequently, bodies speci- fically heavier, will continue to gravitate down- ward, whatever be the depth or the weight of the column of water above them."

The other objection to the trustworthiness of deep soundings is a real one, though it is often exaggerated. There is no doubt whatever about the existence of surface currents of great extent and velocity in the midst of the ocean; they are observed and measured every day as they form a very important factor in the navigator's daily reckoning. Before deep-sea investigation had received the development which it has now, it was quite uncertain whether these currents (the Gulf- stream, or the equatorial current, for instance) were confined to the superficial layer of water, or ex- tended in all their force to the bottom. No sooner, however, had soundings been attempted in them, than it was found that they were comparatively superficial; but, notwithstanding that they were on the surface, and, therefore, immediately under observation, they caused so much deviation in the direction of the sounding-line, and such un- certainty in the stationariness of the ship, that soundings so obtained were always considered uncertain. It was then said, if we have these

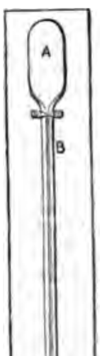
surface currents running from one part of the ocean to another, we must have return currents of some kind, and it is likely that these will be for the most part under-currents; if, now, a surface current, which you have immediately under your eye, gives you so much trouble, how much more will this be the case with an under-current of whose strength, and direction, and depth, you are ignorant?

It must be admitted that when we do meet with currents of the kind imagined, soundings taken in them, whether with wire or hemp line, are very much less to be relied on than those taken in manifestly quiet waters; but, on the other hand, the existence and extent of under-currents has been very much exaggerated. By far the larger portion of the ocean is, for sounding purposes, practically still water. The surface currents of any importance are easily recognised, and so also are the under-currents. Just as a physician can, by bringing his experience to bear on the sounds transmitted to him through the stethoscope, divine what is taking place inside the body of his patient, so the experienced seaman can, by observing the behaviour of his sounding-line, form a fair diagnosis of what is taking place in the depths of the sea. When the sinker passes into a belt of under current, the fact is very soon apparent, and calls for the greatest care in the manœuvring of the ship. Even with the greatest possible care, however, soundings, taken under such circumstances, would always be considered to be of doubtful value. If no bottom is brought up, they should be looked on as very doubtful, and even discarded; if bottom is brought up, then we know that the depth is not greater than the line used, and a correction, suggested by observation and experience, may be applied, which will bring the depth very near the truth. Although, as we have said, by far the greater part of the ocean may be looked on as still water, and, therefore, favourable for investigation with the sounding-line, it is, nevertheless, of great importance to obtain accurate measurements of the depth of water under well marked currents.

It is evident that this cannot be satisfactorily done by the sounding-line alone, and it early occurred to those who thought on the subject that the method which promised most success was that which should give the depth in terms of the height of the column of water; in other words, the barometrical measurement of altitudes was extended from the land to the sea. Many and various instruments have been suggested and used for the purpose. They are all constructed with a view to record the amount of compression produced on a given mass of a certain elastic substance. From the known law regulating the variation in volume of the substance with variation in the pressure, the maximum pressure to which the instrument has been exposed can be deduced, and from the known density of the water, the height of the column of it, which would produce this pressure, can be calculated, and this height is the depth to which the instrument has been sunk. Many different substances have been used for this purpose, and foremost amongst them air, on account of its great compressibility. For deep work, however, this was quickly found to be a great disadvantage, so great, in fact, that it has never been satisfactorily used i depths.

The compressibility of water w 1762 by John Canton, and, fifty extending Canton's original obser pressures, Perkins sank his instrur depths in the North Atlantic Oce from America to this country. Th were glass tubes, sealed at one water, and inverted in a cup of m tube was a steel index which rose w and was retained by a spring at t reached. It could be drawn down instrument so reset by means of a to the outside of the tube. Enc results so obtained, Perkins constru apparatus, in which he could ex ments to enormous pressures, whi directly by the weight which a support. He, at the same time use of these instruments, or p determining great depths. The s was repeated in 1848, by Aimé, t many valuable researches in the and by the United States Coast Sur after. The same idea occurred to of my appointment to the *Challeng* it is one of those ideas which nec themselves to any one who serio the subject. The form of piezomet to me to be best suited for th essentially that of Perkins, wit venient practical modifications.

Fig. 2.



instruments, I used generally dis sometimes sea water, or an equival The bulb and stem of the instrum portioned that, for a depth of one l the apparent contraction of the w length of ten millimetres. Som more, and others less, delicate than in using water, or weak salt soluti material, was that, as the temperat density of these liquids was not

hat obtaining in the great mass of deep oceanic rater, a considerable inaccuracy in the determination of the temperature of the water would make sensible difference in the apparent volume of e liquid, and therefore would not senibly vitiate depth determination so obtained. Unfortately, the vicinity of the temperature of ximum density exercises an influence on the pressibility, which counterbalances its adtages from a thermal point of view. A strong solution would probably be better. Were the perature at the bottom of the ocean subject to at variations, the use of distilled water would be ite inadmissible, but over large areas, its varias are confined to fractions of a degree. Hence, irregularities in the depths given by the meter, and due to this cause, are small though absolutely to be neglected. I am engaged, at esent, in experiments to determine what is the st liquid to use for this purpose.

Another method of measuring the pressure, and hrough it the depth of the sea, is by means of an instrument much resembling, in principle, the aneroid barometer. Its simplest form is that ually given to a mercurial thermometer. When the pressure on the outside of the instrument is creased, the bulb experiences a tendency to lapse. It yields wherever its walls are weakest, if the pressure is kept within the necessary ds, a flattening is produced, which reduces internal volume of the bulb, and forces the cury into the stem; if an index is fitted in steam, its position will indicate that of the emity of the mercury at the moment of test compression. Inventions on this principle been patented over and over again in the e of the last twenty or thirty years.

chief objection to the instrument is that, in ce, it is always filled with mercury. Over eater part of the ocean, the temperature of ter falls as the depth increases. Hence, the ry will be continually retreating, owing to its ction due to fall of temperature, while it is pushed forward by the mechanical collapse bulb. Until these two effects compensate ther, there can be no movement of the index, herefore, no indication of the depth. In of tolerably uniform temperature, as in regions, it ought to do well. Two instrus of this kind were sent to the *Challenger* by asella, but they only reached her at the last before her return to England. They were used twice, and did not on those occasions satisfactory results. Sir William Thomson within the last year, patented an instrument the same principle, where the collapsible elope is a very flat brass tube.

Very analagous to sounding in a current is the ration of sounding from a vessel in motion. have already described the ordinary operation heaving the hand-lead, by means of which ths up to twelve or fifteen fathoms can be ectly observed under ordinary circumstances. eeper water, however, and with vessels running high speed now common amongst mail mers, a self-adjusting apparatus is an essential. within the last few years, the commonest d apparatus of the kind was Massey's soundmachine. In sinking, the friction of the passwater caused a screw fan to rotate, and the number of its rotations was recorded on dials in much the same way as the distance run by a ship is recorded by Massey's patent log. The form of this instrument, requiring, as it does, a system of multiplying wheels, causes it to offer considerable resistance when being hauled on board again; it is, therefore, not suitable, except for vessels going at a moderate speed. Further, if we look to the principle of the instrument, we see that what it in fact registers is the distance travelled by the instrument between the surface and the bottom. If it has been allowed to sink freely, then this distance will be equal to the depth of the water. But if, while sinking, it were exposed to a certain amount of drag, through strain on the sounding-line, it would tend to sink sideways, which would put the screw fan to a disadvantage, and vitiate the determination of depth. Practically, this objection has little force, because, in a ship where it is thought proper to execute soundings of the kind, there will be no difficulty in seeing that the sounding-line runs out freely.

In arranging for taking soundings from quickly moving ships, it is important to have not only an instrument which will be dependent only on the true depth of the water for its indications, but also such mechanical appliances as will enable the operation to be carried out safely and expeditiously. To Sir William Thomson is due the credit of having furnished the practical solution of this as of many other problems. His original apparatus for registering the depths was a glass tube, sealed at one end, and coated internally with a chemical preparation (chromate of silver) the colour of which was changed by the action of sea water. As the tube, with its included air, sank, the volume of the air diminished, and the sea water penetrated further and further into the tube, until the bottom was reached. On rising to the surface again, the elasticity of the air reasserted itself, and eliminated the water which had entered. The height to which the water had risen was given by the extent to which the internal coating of the tube was altered. The indications of this instrument were always very good, and the practical objection to it lies in the fact that a tube only serves for one sounding, and that, therefore, a number of these have to be carried.

In June, 1879, I patented an instrument, in which the degree of compression to which an enclosed mass of air had been subjected, was measured by the water which had gained admittance to the instrument.

As I now use it, the instrument is represented in Fig. 3. It consists of a glass tube open at both ends, but capable of being closed by a stopper or other means. At some part of the tube a spout is introduced, and the tube is bent over through two right-angles immediately above it. When the instrument is to be used, the end is closed, and the line let go; when bottom has been reached, it is brought up again, and we find that a certain amount of water has lodged in the lower part of the tube. It is evident that, as the instrument descends and the air in it is compressed, the water forces its way in through an orifice, and past the spout. This spout is so formed that it delivers the water against the walls of the tube, down which it runs, and collects at the bottom. When the motion of ascent begins, the air, by its elasticity, tends to re-

cover its original volume, and expands in the direction of greatest freedom. Now, all the water which has entered has collected below the spout, consequently, in re-expanding, this water will be left undisturbed.

Assuming that the volume of the mass of air in the instrument varies inversely with the pressure to which it is subjected, we require, in order to be

FIG. 3.

FIG. 4.

able to construct a scale for our instrument, and so to interpret its results, to know the total volume of the tube, the volume of the part which I call the vestibule, the dimensions and volume of the narrow tube, and of the wide one. *Then, if* V be the total volume of the tube,
and v that of the vestibule, the amou
which gains admittance when the pres
from one to p atmospheres is—

$$v^1 = V - \frac{V}{p} - v$$
$$= V\frac{p-1}{p} - v$$

The methods by which a correct scal
can be easily applied to any instrume
graved either on the glass or on the m
on both, are details of practical instrum
which need not detain us.

Convenient dimensions for such a s
strument are—Total volume, twenty
metres; volume of vestibule, one
metre; length, forty to fifty centi
hauling in the sounding line to a
way, the machine comes to the su
siderable distance astern of the ship,
to be towed through the wake, nece
dipping under the seas. Each dip wh
constitutes an independent, though sh
ing, and the volume of the vestibule
proportioned to the volume of the inst
during such immersions no water sl
spout. When the instrument has b
is at once available for a fresh soundin
necessary to remove the stopper,
water run out, and then replace the st
Fig. 4 represents an instrument mod
it can be used either for great or for
according as either end is closed.*

Sir William Thomson, in his latest
of patent (February, 1880), recommen
three instruments, constructed some
lines of the above instrument, but co
of sizes so apportioned that each shall
sensitive at certain depths. He also
the use of the "elastic bottle gauge
above, combined with the triple air
gauge, to give measurements of from
300 or 400 fathoms.

It may reasonably be doubted if it
a matter of any importance to the prac
to obtain a positive sounding in 300 o
of water, either with or without stop
and to do so without checking her wa
very serious undertaking. The wei
will not sink at a greater rate tha
fathoms per minute, or four minu
hundred fathoms, and during four m
going not more than 10 knots per h
advanced by 660 fathoms, so that, wh
been struck, there will be at least
fathoms of wire, which, even with ste
be reeled in under a quarter of an ho

The second and more mechanical

* After the above was written, my attention
Hydrographer, Captain Evans, to an instrum
principle, though differing greatly in the detail
invented by Ericssen, and used successfully on
her Majesty's ships. It is described and figure
Magazine for 1836, and is reported on very favou
Bisson, of H.M.S. *Partridge*, who was acco
inventor, and they obtained successful sounding
80 fathoms, while going at a rate of six knots
with the sounding machine, Ericssen brought o
wire for use, in place of sounding line. Captai
me that it had been constantly and successful
own eyes, when engaged in the survey of the N
in H.M.S. *Acheron*, in 1848, and that it had
faction.

of deep sounding while under way, has red by Sir William in an elegant and form. His navigational wire sounding ains all that is requisite in the smallest compass. For my own work, I have me slight modifications in the details. consists of a solid hard wood core, thowell painted, and surrounded with a brass he hollow of which the wire is wound, le of which, on each side, is a break pulley. soft hemp line are used for the breaks. which is used purely as a friction break is at one end to a spring balance, by means any definite pressure can be put on the e other is used as a locking break, that is is taken one complete turn round this the direction in which it revolves when is running out. When the weight has erved to strike the bottom, this break is tightened, which instantly locks the reel handles are manned, the breaks thrown he wire wound in. I depart, also, from Sir Thomson's practice in using galvanised in right steel wire. In order to allow for any weakening effect of the galvanising, I wire a size larger. In a small vessel like rd, I found it very inconvenient working on the taffrail. I have it now well in id the wire leads out through a metal ecially constructed for the purpose, and to the flag pole, as high up as a man can n this way the work is carried out withulty. The galvanising is a perfect pro-o the wire, and all work with tanks and solutions is spared. Instead of having a n link at the end of the wire, I reeve the ie wire through a piece of ¼-inch blockipe, about 15 inches long, and then bend and splice up the end of the wire so as to eye, to which the stray line for sinker ding machine can be attached.

U.S. Coast Survey Report for 1857, a genious sounding instrument is described r. Hunt. The instrument consists of an t bag, made of flexible material, with a ible tube attached to it. This bag, being th air, is sunk to the bottom (in a modeth of water), preferably by a heavy grating surrounds and protects it. The other end flexible tube is connected with a Bourdon's -gauge in the ship or boat. If, now, this towed over the bottom, and the pressure-observed on board, an exact profile of the is given. I am not aware that this instrus ever been much used for harbour surveyr which it was intended—and it is not to see where practical difficulties would be o occur; it has, however, been used with ccess as a tide-gauge, and it is clear that, a purpose, it possesses many advantages. being securely anchored under water, it onnected by a pipe of any length with the ng gauge, or a recording instrument under

he purpose of observing the temperature of ers below the surface in lakes and seas, ses of thermometers have been used, ordinary thermometers and self-register-.* The earliest observations were made with the ordinary thermometer, and it was used in one or two ways; either it was sunk itself to the desired depth, and was so enveloped and protected by badly conducting material, that in bringing it up again through the layers of water of different temperature it had not time to alter its own temperature, or a quantity of the water at the desired depth was enclosed in a bucket of suitable construction, and brought to the surface, and then immediately tested with the thermometer. Many very excellent and trustworthy observations exist, which have been made in one of these ways. Our first knowledge of the temperature of the deep water of fresh-water lakes was obtained from the observations of De Saussure, on the lakes of Switzerland, made with a thermometer, so padded and protected that it could be drawn up through 1,000 feet of water, of any temperature likely to be found in Nature, without sensibly altering its temperature.

The self-acting bucket, or sea-gauge, was used at an earlier date in the determination of the temperature of the deep water of the ocean. The accuracy of the results obtained by this method depends greatly on the skill of the observer. In the case of De Saussure, and of Fischer and Brunner, the results are clearly to be relied on implicitly. In the experiments with the sea-bucket, also, excellent results have been obtained. The results obtained by both methods of experimenting will be the more accurate the more uniform the temperature of the water. The temperature, especially of the bottom water, has also frequently been determined by bringing up a quantity of the mud, and taking its temperature when it arrives on board. This method also gives very satisfactory results when a considerable quantity of mud is at disposal.

Self-Registering Thermometers. — By far the greatest number of observations has been made with self-registering thermometers of one form or another. The first self-registering thermometer was made by Cavendish. He constructed both a maximum and minimum thermometer, and they were of the kind called by the French *à diversement* out-flow thermometers. In fact, his maximum thermometer is in every particular identical with that known in France as Walferdin's; his minimum is on the same principle, but has a U-formed stem instead of a straight one. The disadvantages of this form of thermometer are two—namely, the indications are not continuous, but by jerks, depending on the size of the mercury drops, and they require to be constantly set, the maximum at a higher, and the minimum at a lower temperature than the one to be observed; they also require constant comparison with a standard. They are, therefore, not suitable for use where many observations have to be made expeditiously.

In the year 1782, Six published a description of the combined maximum and minimum thermometer which bears his name, and which has since continued to assert its place among meteorological instruments as perhaps the best self-registering thermometer. The instrument is too well-known to require particular description. It may, however, be noted that Six himself did not use a hair for a spring to keep his indices from falling down, but a fine glass thread soldered to the top of the index, and sticking up in a direction very slightly inclined to that of the length of the index, so that it pressed

* ...edings of the Royal Society of Edinburgh, 1880.

gently against the sides of the tube. The advantage of the glass over the hair is that it does not lose its elasticity; but, on the other hand, the index takes up more room, and requires a thermometer with a larger stem.

Maximum and minimum thermometers, such as Cavendish's and Six's, when used for deep-sea exploration, show only the maximum and minimum temperatures to which they have been exposed in any one excursion, and a single observation with such a thermometer does not give us with certainty the temperature of the water at the depth to which it has been sunk. Hence, if we had a right to assume that the temperature of a sea or lake might vary in any conceivable way with the depth, these instruments would be valueless. We have, however, no right to make this assumption; we know, on the contrary, that in all seas whose surface is not exposed to a freezing temperature, the temperature of the water will, as a rule, diminish as the depth increases, that, therefore, the minimum temperature, as shown by the self-registering thermometer, will, in fact be the temperature at the greatest depth attained by this thermometer. Hence, in such cases, this instrument is to be relied on, and more especially when series of temperatures are taken—that is, when the temperatures at different depths in the same locality are taken, so that the evidence of the decrease of temperature with the increase of depth, is rendered as strong as possible. In order to render an account of the state of any lake or sea, as regards temperature, it is absolutely necessary to have such serial observations; hence, for such investigations, the maximum and minimum thermometer is not only trustworthy, but a most valuable and, indeed, indispensable instrument, for it has the great advantage that, as it is in the strictest sense self-registering, any number can be attached to the same line, and so, at one haul, the temperature can be observed at a number of different depths.

For isolated observations, the thermometers just described are not so satisfactory, and a very great amount of ingenuity has been displayed in the invention of machines for registering the actual temperature of the water at any depth, independently of that of the water above it.

None of the instruments devised for this purpose have been strictly self-registering; they have all required some assistance from the observer, who, by various forms of mechanical appliance, brings about a catastrophe which leaves its mark on the condition of the instrument. It is obvious that any control which an observer may have over an instrument separated from him by, it may be, three or four miles of cord, is very limited, and is, in fact, confined to his ability to move it towards or from him. By a simple mechanical contrivance, this longitudinal motion may be made to produce one of rotation, and, in fact, the assistance afforded by the observer to the thermometer, to enable it to register its own temperature, consists in his turning it either upside down or through a whole circle when it has reached the desired depth. The first observer who made use of this device was Aimé. His working arrangement is described in "Ann. Chim. Phys.," 1843 [3], vii., p. 497. It is worked by a weight, which is allowed to slip down the line, and which then sets free the apparatus.

His *thermomètre à bascule*, along with a num of ingenious modifications of existing form described in the same journal, 1845 [3], xv., It was unfortunately only after he was oblig leave the Mediteranean, which had been the s of his labours, that he invented the very ele combination of thermometers by which he enabled to ascertain the temperature at any d no matter what the intervening distribution n be. It is described in the memoir just cited consists of two outflow thermometers, so structed that the one of them registers the su the rises of temperature, and the other the su the falls of temperature, to which it is expos any excursion. When they have reached required depth, they are inverted, and on thei back to the surface they register, as above desc the rises and falls of temperature to which th exposed. If r be the sum of the rises of tem ture, and f the sum of the falls, s the temper at the depth where they were inverted wi $a = s + r - f$.

If they are allowed to register on the way d and then inverted at the greatest depth, so a to register on the way up, the effect will be cisely the same, though the functions of the mometers will be reversed.

Beautiful and ingenious as Aimé's thermom are, they have the disadvantages common t outflow thermometers; they are neither si enough nor handy enough for work invol many observations. The inverting thermom patented by Messrs. Negretti and Zambra, sat the conditions required of a thermomete isolated observations as completely as ca hoped for. It is a mercurial thermometer; bore of the stem is contracted to the sm possible diameter at a point about an inch the neck of the bulb. As long as the thermo is standing vertically, stem uppermost, the me is continuous in stem and bulb; but if it b verted, the mercury parts at the contractio portion in the stem falling down into the The stem is graduated from the point to the bulb, and the temperature, at the mome inversion, is read off by the height of the me in the end of the stem. This thermometer in two varieties, the one with a U-formed which requires to be turned completely The turning arrangement for the latter instr is a somewhat elaborate and expensive instr but it answers its purpose. The inverting ar ment, supplied with the half-turn thermo is somewhat clumsy and unsatisfactory. half-turn instrument, when fitted with a investing arrangement, is to be preferred others in all work at moderate depths.

Sources of Error in the Indications of Thermometers.—When an ordinary thermo protected by badly-conducting envelopes, it is obviously exposed to alteration of temp by being pulled through warmer or colde on its way to the surface. Whether any error is likely to result from this cause, determined in each particular case by expe The more perfectly it resists change of temper the longer it will take to assume the tempe of the water. De Saussure left his therm down for twelve or fourteen hours for each vation, so that this method is now seldom

, also, the method which depends on up a sample of water in a vessel fitted irpose, and taking its temperature with ry thermometer, when it reaches the sur- been discontinued; for although it does more time than would be necessary for lown a thermometer and bringing it up, ssible to bring up water from great depths climates without sensible change of tem-

ase of outflow thermometers, the delicacy strument is limited by the size of the lrops. In the inverting thermometers of and Zambra an error may arise from the of volume of the mercury in the stem, at rature at which it was inverted and at hich it is read. In an extreme case this unt to as much as O. 4° F.; it can, how- llowed for.

's instrument there is a possible error eness of the indices, in consequence of ey are apt to be shaken out of their places rring of the line. Errors from this source oided to a great extent by attaching the eter to the line, by means of an elastic or ber tube.

self-registering instruments are liable to m the effects of pressure. The pressure thermometer is never greater than that of osphere when it is sealed up. It may, , be exposed outside to a pressure of 500 tmospheres. The effect of this difference ire on the outside and inside of the glass is to make it tend to collapse. The bulb iermometer is squeezed, and its volume, in ence, diminished. The liquid which it is thereby forced into the stem, and its t volume is greater than it would have d there been no excess of pressure on the of the instrument. The temperature of the ent is measured by the apparent volume of uid which it contains; hence the effect of e is to raise the observed temperature above temperature. Parrot and Lenz, in 1832, series of experiments on the effect of e on thermometers. They experimented at s up to 100 atmospheres, and observed ces between the apparent and the true tures of as much as 20° C. They found the same instrument the compression was proportional to the pressure. They used a meter as a manometer. After this date it al to attempt some kind of protection for istering thermometers.

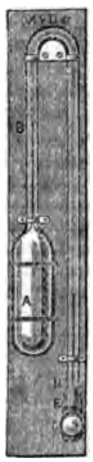
e with straight stems, such as Walferdin's m, were sealed up in glass tubes, and so tely protected. Those whose stems were d to be enclosed in metal cases closed with . This form of protection never answered it was impossible to screw on the cover so at the water, under the great pressures met considerable depth, would not find its way rder not to have to abandon the use of eters of the conveninent form of Six's, the protecting the bulb only was hit upon, pears that the first thermometer of this s used by Captain Pullen, on board *Cyclops*. The effect of pressure on the quite insignificant, and under ordinary nces, insensible. For, in nearly all seas where the surface temperature is over 40° Fahr., the temperature of the water dimished as the depth increases, and, therefore, it is the minimum leg which is used, and the effective part of it is that filled with spirit, which may have a length of, at most, three inches. The effect of pressure in diminishing the volume of a short piece of thermometer tubing must certainly be very small, but its actual value can only be determined by removing the bulb, and taking the piece of the stem between the mercury and the neck of the bulb as the bulb of a new thermometer, and determining experimentally the effect of pressure on it. An approximation to the effect may be made by exposing the thermometer to various high pressures, at known temperatures, and observing the rise of the maximum index, then removing the bulb, and calibriating the stem. Knowing, then, the ratio of the volume of this part of the minimum leg, filled with spirit to the to the whole volume, from the bulb to the maximum index, it may be assumed that the compression will be in the same ratio. And this value will probably be greater than the real one, for the compression of the water produces of itself a certain rise of temperature, and, consequently, rises the maximum index. This can, however, be estimated, either by a comparison with a completely protected thermometer, or by bringing the minimum index also home on the mercury before raising the pressure. If, then, there has been a rise of temperature caused by compression, there will be a corresponding lowering of temperature on relieving the pressure. If the compression apparatus be allowed to stand after the pressure is up, until it has disiepated the heat evolved by the compression, the relief of pressure will cause a corresponding absorption of heat, which will show itself in the position of the minimum index. Some experiments which I have made in this direction show a lowering of temperature of 0·3° Fahr., for the relief of a pressure of 2¼ tons per square inch, the whole rise of the maximum index having been 1·8° Fahr. We may, I think, be quite certain that when the minimum leg is the one used, and the temperature low, the error caused by the effect of pressure on the stem is inappreciable. Cavendish, who invented the self-registering thermometer, foresaw also the most important of the uses to which it could be applied. Thus he suggests that the higher regions of the atmosphere might be investigated by attaching it to a kite—balloons not having been invented. With regard to deep sea explorations, he says:—

"If instruments of the nature above described were to be used for finding the temper of the sea at great depths, some alteration would be necessary in the construction of them, principally on account of the great pressure of the water, the ill effect of which can, I believe, be prevented no other way than by leaving the tube open."

This was written in 1757, and it was not till 1762, as already stated, that Canton proved that liquids are compressible. Cavendish, therefore, hoped that as the pressure would not produce distortion of the glass when the tube was open, it would have no visible effect on the apparent volume of the liquid. The device of leaving his thermometer open at the end was adopted by Aimé in some of his experiments, the effect of pressure on the apparent volume of the

liquid being determined independently, and a correction applied accordingly. I devised and constructed a mercurial thermometer, or piezometer (Fig. 5) on the same principle, but my object in admitting the water pressure to the inside of the instrument, was to utilise it in shifting the scale of the thermometer as the depths changed. The thing registered in such instruments is always the apparent volume of the liquid, and this varies with the temperature and the pressure. Hence the indications will represent the sum of the effects of the change of temperature and of pressure. If from any independent source we know either of these, we can determine the other. In a sea of uniform temperature throughout its depth, the apparent volume of the liquid would diminish as the pressure increased, and if the temperature increased with the depth, the apparent volume of the liquid would diminish at a slower rate; but it would be always possible to determine the true temperature as long as it did not increase at so great a rate as to dilate the liquid more than it was compressed by the increasing pressure. For the investigation of

Fig. 5.



seas such as the Mediteranean, this form of instrument is most valuable. The method of determining accurately both depth and temperature from the combined reading of a mercury and a water piezometer is explained in the paper communicated to the Chemical Society.*

In the great majority of cases, the most convenient instrument to use is the form of Six's thermometer with protected bulb known as the Miller-Casella thermometer, with the following additions and improvements, which Mr. Casella has applied to them at my suggestion:—The size of the instrument is increased so that the degrees are wider apart, a degree Fahrenheit on the minimum leg occupying about three millimetres of its length. Besides the scale of degrees which is attached in enamelled slips to the vulcanite at the sides of the stem, there is an arbitrary (millimetre) scale etched on the stem itself. The valves of the division of this scale are ascertained by a careful comparison with a standard thermometer. It is thus possible to read with certainty to a quarter o or a twelfth of a degree Fahrenheit. to the scale not being rigidly attach mometer, and to the difficulty of d height of the index by reference to side of, instead of over it, are elimin by having the ordinary scale at the strument can be used indepen arbitrary scale, and, even where scale is principally relied on, the s enables the observer to know very the true temperature at the mome tion, without reference to tables, on every occasion the reading on chance of errors from misreading duced. The maximum leg, which used, is of larger bore than the min degrees, therefore, are closer, and t of the instrument may rise as high without the index entering the This is a detail of considerable pra ance, for it is impossible always thermometers, when on deck, from of the sun, which would speedil maximum side of the thermomete were as limited as that of the mini

It will be seen, from what has there is no one instrument wh conditions required of a perfect mometer. It is necessary, ther investigator to use his judgment i of the instrument best suited for case before him. In order to be possibly occurring cases, he shoul with thermometers of (a) the Mille with improvements just described; piezometer, (c) the Negretti and Za thermometer. It is well to have first class (a), as any number of attached to the line at different de much time saved. In my own pract use four or five at a time. It i to exceed this number, as the l accident would be too heavy. C distribution of temperature actu lakes and seas of warm and tempera is the most generally useful ins thorough investigation by means observations is intended. In and frequently occurring case c sea, containing a large mass of v no variations of temperature w this instrument, it must be re mercury piezometer (b), which posse tage that the position of the ther shifts along the stem according varies. Also, any number of the at the same time at different c same line. The inverting thermon Negretti and Zambra (c) is the in suitable for isolated observations. very great use for supplementing the observations with the othe especially in the case of sea lochs c the temperature distribution is o turbed by the imperfect mixture of water.

For the successful and expeditio of deep-sea temperature observatio gator should be furnished with im

* "Journal of Chemical Society," October, 1878. The blocks of Figs. 2, 5, 6 have been kindly lent by the Council of the Chemical Society.

mometer for the bulk of the work, and piezometer and the investing thermo- articular cases. All the thermometers, type, should be carefully compared l standard, and the results stated in scale.

etermination of the specific gravity of is necessary to have an instrument of delicacy, which can be used in all ather at sea. The specific gravity of ordinarily determined in one of two with the specific gravity bottle, when of a known volume of the liquid is rved, or with the hydrometer, when of a known weight is observed. A ification of the hydrometer, namely, vity bulbs, has long been in use for oses, and they have been used by Dr. nd others for sea-work. The only ob- heir employment, in work of purely erest, is that each bulb, being in effect ydrometer, has to be separately tested ght and volume, and for change of ensity with changes of temperature. rge number of bulbs which is neces- volves an enormous amount of labour ithout corresponding advantage. Sets ters, graduated so as to include all vities naturally occurring in the sea, sed. When each hydrometer has been of the requisite delicacy, and of work- tions, it is necessary to have a set of ters; and the same objection obtains e of the bulbs. For the work of the n instrument of suitable size and pro- s constructed. Its stem carried an le (millimetres), and was very carefully the weight of the whole instrument efully determined, and also the dilata- body. The instrument was entirely y a contrivance similar to that used in hydrometer, weights could be placed sub-cavity of the stem. By this means usefulness of one hydrometer can be ex- eyond the limits occurring naturally

ting independently this work, I have some of the details of the instrument, ever, in any way altering its general In the *Challenger* instrument, the body er, containing about four diameters in in the heavier form it is a sphere of me volume, this materially reducing the instrument. Instead of a small brass eights to be laid on it, the weights rass cylinders, closed at one end, and a flange at the open end with others of flat rings, which can be slipped lindrical weights, and then rest on These are small mechanical details, ever, greatly affect the handiness of ent, and they are therefore of im- The following is a description of the used for the whole of the work the cruise of the *Challenger*. The carries a millimetre scale 10 centi- has an outside diameter of about 3 the external volume of the divided g 0·8607 cubic centimetre; the mean he body is 160·15 cubic centimetres, and the weight of the glass instrument is 160·0405 grammes. With this volume and weight, it floats in distilled water of 16° C. at about the lowest division (100) of the scale. In order to make it serviceable for heavier waters, a small brass table is made to rest on the top of the stem, of such a weight that it depresses the instrument in distilled water of 16° C. to about the topmost division (0) of the scale. By means of a series of six weights, multiples by 1, 2, 3, 4, 5, and 6, of the weight of the table, specific gravities between 1·00000 and 1·03400 can be observed. It is not necessary that these weights should be accurate multiples of the weight of the table; it is sufficient if they approach it within a centigramme, and their actual weight be known with accuracy. The weights of the table and weights in actual use are:—

Weight of table		0·8360 grammes.
Weight of weight No.	I.	0·8560 "
" "	II.	1·6010 "
" "	III.	2·4225 "
" "	IV.	3·1245 "
" "	V.	4·0710 "
" "	VI.	4·8245 "

For oceanic waters, the hydrometer is always used with the table, and either No. IV. or No. V. weight.

When the mechanical part of the construction of the instrument was finished, with the exception of the closing of the top of the stem (which, instead, was widened into a funnel-shape, large enough to receive the ordinary decigramme weights), the calibration of the stem was effected by loading the stem with successive weights, and observing the consequent depressions in distilled water of known temperature. This done, the top was sealed up, and the instrument carefully weighed. The expansion of the body with temperature was determined in a similar manner, by reading the instrument in distilled water of various temperatures. The co-efficient of expansion of the glass was then found to be 0 000029 per degree Centigrade.

For using this instrument at sea, about 900 cubic centimetres of sea-water are taken, and the containing cylinder placed on a swinging table, in a position as near the centre of the ship as possible. The observation with the hydrometer, loaded with the necessary table and weight, is then effected in the ordinary way, the accuracy of the readings being but little affected by rolling; pitching, however, is found to have a distinctly disturbing effect; and when it is in any way violent, it is advisable to store the specimen of water till the weather improves.

The temperature of the water at the time of observation is determined by one of Geissler's "Normal" or standard thermometers, graduated into tenths of a degree Centigrade; and it is essential for the accuracy of the results that the water, during the observations of the hydrometer, should be sensibly at the same temperature as the atmosphere, otherwise the changing temperature of the water makes the readings of both the hydrometer and the thermometer uncertain. At low temperature (below 10° or 12° C.) a tenth of a degree makes no sensible difference in the resulting specific gravity; but, at the high temperatures always found at the surface of tropical seas, rising sometimes to 30° C., the same difference of tempera-

ture may make a difference of three to four in the resulting specific gravity.

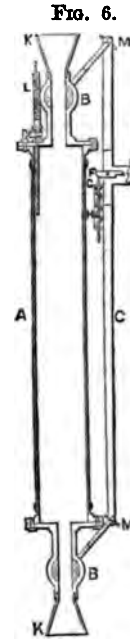
Having obtained the specific gravity of the water in question, at a temperature which depends upon that of the air at the time, it is necessary, in order that the results may be comparable, to reduce them to their values at one common temperature. For this purpose a knowledge of the expansion of sea-water with temperature is necessary.

This had been determined with sufficient accuracy for low temperatures by Despretz and others; but as the temperatures at which specific gravity observations are usually made are comparatively high, their results were of but little use, directed as they were chiefly to the determination of the freezing and maximum density points. When the late Captain Maury was developing his theory of oceanic circulation, owing to difference of density of the water in its different parts, he found the want of information on this important subject. At his request the late Professor Hubbard, of the National Observatory, United States, instituted a series of experiments, from which he was enabled to lay down a curve of the volumes of sea-water at all temperatures, from considerably below the freezing point to much above what obtains even in the hottest seas. The results are published in Maury's "Sailing Directions," 1858, vol. i., p. 237, and have evidently been carried out with great care. The composition of different oceanic waters varies, even in extreme cases, within such close limits, that the law of thermal expansions is sensibly the same for all of them; of this, Hubbard's experiments afford satisfactory proof. In the table which gives the results of all his experiments, he takes the volume of water at 60° Fahr. as his unit. In order to avoid much useless calculation, I have been in the habit of reducing my results to the same temperature (15·56° C.), while, for a like reason, I have retained the specific gravity of distilled water at 4° C. as the unit. The choice of a common temperature, to which the results should be reduced, and of a unit of specific gravities, is a purely conventional matter; and in choosing the above-mentioned ones, in the first instance, I was moved solely by a desire to save calculation. For every water, however, there is one temperature to which it would be natural to reduce its specific gravity, namely, the temperature which the water had when in its place in the ocean; and in this sense all my results during the cruise have been reduced. Hubbard's table of the change of volume of a mass of sea-water, with change of temperature, enables us very easily to reduce any observed specific gravity from the temperature of observation to any other temperature, say 15·56° C.

Collection of Samples of Water.—The water from the bottom was usually collected in the so-called "slip" water-bottle, which has been described by Professor Jacobsen. Water from intermediate depths is obtained in an instrument represented in section in Fig. 6. It is made entirely of brass, which, however, might advantageously be nickel-plated. It consists of a cylinder, A, terminated at both ends by similar stop-cocks, B B, which are connected by the rod, C. This rod carries, near its upper extremity, a piece of stout sheet brass, D, 10 centimetres long by 15 broad, soldered to the casting, E, which is movable about the axis, *e*. *The function of this* part of the apparatus will be more easily explained by describing th tions necessary when collecting water.

When intermediate water is to be ol water-bottle is firmly attached to th line, which carries at its end usually 1 cwt. lead; the stop-cocks are then op

FIG. 6.



them, with the rod, C, the position in the figure. The line is then lower by hand, until the water-bottle is c surface, when it is let go, and allowed to run out without a chec its passage downwards, the water cc through it, being considerably assis conical end pieces, K, K. When the req has been reached, the line is checked same mark, and finally hauled in altog donkey-engine. When the line is h first, the flap D falls down into a position, when it is caught by the m of brass, F, which moves round an a supported on the side opposite to E, b which rests on the spiral spring, H. rushing past D, when thus in a horizon exercises a sufficient pressure upon the the stop-cocks, B, B. When the speed the bottle is hauled through the water the pressure on D becomes so great, comes the tension of the spring, H, a the catch, F, when the rest of the jour is performed with the flap, D, han and therefore offering the least pos ance to the water. The object of a ing in only a couple of fathoms letting the line go again, is to cocks being closed. For, supposin first hauling in they were not q by letting the instrument descend water, the flap, D, sets itself again, a ing in, it shuts down the stop-cocks before but partially closed; or, if

closed before, it only shuts them the tighter. When the water-bottle has been brought up, it is only necessary to substitute for the lowermost brass funnel a small nozzle, when the water may be tapped into any vessel destined to receive it. This done, the bottle may be at once lowered to any other required depth, much time being spared by not having to detach it each time. At the upper end of the bottle a small spring safety valve, I, is introduced, in order that the considerably denser water from below may be able to make room for itself as the surface is approached. In order that the instrument may properly do its work, it is evident that, first, the stop-cocks should be so stiff that the weight attached to their levers be not sufficient to close them; and, secondly, the spring, H, should be so strong as to ensure the shutting of the cocks before it itself gives way. These conditions are secured by the following means of adjustment. The stop-cocks can be made stiff in the usual way, by tightening the screws which screw the "keys" in the bands; the tension of the spring, H, can be increased or diminished by means of a screw at the lower end of the tube containing it; and the mobility of the stop-cock can be regulated by means of the screws, M M. Although from this description, the operations of adjustment may appear complicated, it is, in fact, practically very simple. After the first time of use, it is rare that any further adjustment is required than a turn of the screws, M M. The diameter of the apertures at either end is necessarily smaller than that of the the cylinder; it is, therefore, impossible for the water in it to be entirely changed while descending through a distance equal to its own length. It became a question, therefore, for experiment to decide what actually was the rate of change of water. To this end, a few experiments were made in a fresh-water lake. The bottom being filled with water containing some yellow prussiate of potash, was sunk in the lake, until the surface of the water was on a level with the upper stop-cock, when the stop-cocks were opened, and the line let go. On being brought up again, the contents were treated with the solution of perchloride of iron. It was found that, when the bottle had been sunk to a depth of a fathom and a-half, the water had been entirely changed, the iron solution being wholly without action on it. We may be certain, then, that the water which we obtain by this means is an average of the last two fathoms through which the bottle has passed.

The weight used as a sinker should be chosen so as to impart sufficient velocity not to lose time unnecessarily over the operation, and, at the same time, not to give an excessive velocity at the depth where the water is to be collected, because the rate of change of water depends on the friction of the water inside the bottle, and so the velocity of descent. In practice, for depths over 100 fathoms, a weight of 112 lbs. was used, and for depths from 25 up to 100 fathoms, a weight of 56 lbs. was used. For less depths the weight of the bottle itself was sufficient, The velocity of descent at the depth where the water is to be collected should not exceed 12 feet per second. The mean velocity for the interval between 75 and 100 fathoms from the surface was, with 66 lbs., nine feet, and with 112 lbs., eleven and a-half feet per second.

When once let go, it is essential that the line should run out to the required depth without a check; it is then, however, immaterial, as far as the water bottle is concerned, what interruptions occur in heaving in. The fulfilment of the condition of running out without a check never presented any difficulty on board the *Challenger*, depending as it does on the care of those who take the line. When, however, by accident a check does occur, the line is stopped, and the water-bottle brought up again, reset, and sent down again. In order to utilise any such accidents, it is usual to take the water from the greatest depth first; then, if a check does occur, it may occur at one of the desired intermediate depths, and so no time would be lost. In designing the water-bottle, it had been my intention to use it not only for collecting water, but also as a flask, so that the atmospheric gases could be boiled out of it without transvasing the water. In practice, however, I have not been able to get air-tight stopcocks, besides which, it would make an inconveniently large apparatus in a very small laboratory. I have spoken of this water-bottle as being only used for intermediate waters, but there is no reason why it should not be used for bottom water; indeed, where the sounding lead does not weigh over 1 cwt., it is frequently used for this purpose. In the case of deep soundings, however, where a weight of three, and sometimes four hundred-weight is used, the "slip" water-bottle is always preferred.

DISCUSSION.

A Member asked how the depth of the mud at the bottom of the sea was determined; and how the instruments would be affected by it, because when the instrument touched the soft mud, it would not act as it would if the ground were hard.

The Chairman said that having been Commander of the *Challenger*, it was scarcely necessary to say how important he considered the subject on which Mr. Buchanan had been speaking. It was most important for telegraphic purposes to know not only the depth of the sea, but its properties. The *Challenger* expedition had been found fault with for not adopting at once the present system of sounding, dredging, and taking temperatures; but all these things were progressive, and, thanks to Sir William Thomson and the telegraphic companies who were also interested in these matters, and to Mr. Buchanan who was working at it independently for the love of the thing, satisfactory progress had been made. They were pretty well satisfied with the present apparatus for sounding, for which purpose they now all used wire, because they could get the sounding so quickly. In fact, when laying telegraphic cables, a second ship, with a wire-rope and lead 35 lbs. in weight, could follow and measure the depth every 20 or 30 miles as they went along, and keep up with the one paying out the cable at the rate of five or six knots an hour. In taking serial temperatures, great care was required, because the thermometers were so valuable—not exactly in themselves, although they were very delicate instruments—but because on the return of a ship after three years' work, the thermometers which had been used in those observations were worth any amount of money for reference in future, their errors having been determined. At present, therefore, they had not sufficient confidence in wire-rope for temperature soundings. As regards dredg-

ing, they now learned that telegraph ships had given up the wire-rope for picking up old cables, on account of the weight; so that at present wire was only used for soundings. The United States Government, in their operations in the Gulf of Mexico year after year, had attained a very high state of perfection. The English dredges were just bags which scooped up a cargo of mud, and could not be scraped along the bottom. But the Americans had improved upon that, and had an iron frame, in the form of a parallelogram, which was far more successful. The great desideratum now was, not to sound quicker, but to attain more exactness. As to temperature, they had got to the decimal part of a degree, which was near enough, but they wanted more information as to the movement of the water at the bottom. All the measurements as yet taken in connection with ocean currents and tidal movements, were on the surface; but there was a great deal of movement at the bottom, and a knowledge of it was very requisite, especially for telegraphic purposes. The motion caused by a heavy sea was not supposed to extend more than 40 or 50 fathoms down, but telegraphic cables wore out at depths of from 300 to 400 fathoms, so that there must be motion going on down there. The barrier across the entrance to the Mediterranean was about 200 fathoms, or 1,200 feet, and water below that level did not get into the Mediterranean. If you sank a thermometer, it showed the same temperature at 200 fathoms as at 2,000, so that the bottom water did not move at all. In the Atlantic or Pacific, if a thermometer denoted that the temperature of the sea got colder and colder as the depth increased, it showed that in such places there must be an enormous movement of cold water, probably from the Poles, that cushioned up against the barriers, and got stopped. The great desideratum now, therefore, was an apparatus to denote the movement of water at different depths. With regard to the temperature of the mud at the bottom, when Sir Wyville Thomson and other gentlemen were sifting out the mud for shells and minute organisms, no matter whether they were on the equator or elsewhere, their fingers were nearly frost-bitten, and it was a constant practice to cool the wine by putting the bottles in this mud. A thermometer with a wooden case, such as had been shown, if sunk to the depth of a mile, would have the whole of the air in the pores of the wood squeezed out; afterwards it would sink at once in water, if immersed. Between New Guinea and Australia, the trawl often came up literally full of wood and leaves from the bottom, which must have become water-logged by the same means. In fact, there was a coal formation going on at the mouth of some of these rivers, which were not carrying down soil enough to cover the leaves and wood, which, as they got thoroughly soaked, sank, and kept sinking as they became more dense from the pressure of water, until they reached the bottom. It had been supposed that the water got gradually colder and colder as the depth increased; but in the Antarctic region, he felt perfectly certain that they tapped a stratum of warm water under the cold, though they could not measure it. He wrote home from Australia for such a thermometer as Mr. Negretti had now arranged. In the Antarctic regions, whether from the greater density of the water or from some other reason, there was a cold stratum at the top, then a warm stratum, and then a cold stratum again underneath. Similar observations were required near the North Pole also, but after all, the great desideratum at present was a method of obtaining observations of submarine currents.

Mr. Buchanan, in reply to the question as to the effect of mud on the sounding instruments, said that water bottles was so delicately slung, that the least support would tumble off: they did sometimes come up full of mud instead of water, but very rarely. He never remembered a failure from the sounding weight not slipping. The only difficulty with the wa was that now and then it would choke itself b slipping the wrong way, but that very seldom

The Chairman then proposed a vote of than Buchanan, which was carried unanimously.

INDIAN SECTION.

Friday, March 4, 1881; Sir Richard Bart., G.C.S.I., D.C.L., in the chair.

The Chairman said, in introducing Mr. M the meeting, that he thought he could pro would have a paper both agreeable and i He had known Mr. Maclean in India, wh been considered—and justly considered—an of the press. He wished there had been a larger audience on the present occasion, b not large, it was select. And he must r reader of the paper that, through the *Jour* Society, he had an appreciative and influentia of between 3,000 and 4,000 members.

The paper read was on—

THE RESULTS OF BRITISH RUI INDIA.

By J. M. Maclean.

Perhaps no question has been more hotl of late years than the value to the people country of the political connexion e between England and India. In less en ages the benefits derived by the ruling all events, from an extended empire, sidered to be too manifest to require di and while, a century ago, the American which revolted from Great Britain, gai champions of the justice of their cause e British Parliament, the science of political phy was then so undeveloped, that stat all parties agreed in deploring, as a calamity, that separation which is appl certain Englishmen in our own day as o greatest blessings that could have been upon this country. On the Continent o the old-fashioned view of the advanta State of Imperial dominion still holds it among the most advanced thinkers. I ne remind you, for instance, of the opinion by De Tocqueville, in 1857, that it was the p of India which secured to England the consideration she enjoys throughout t and that the loss of her great dependen be quickly followed by her decline to th a second-rate power. In England, ho modern school of political essayists, w themselves on their superiority to vulg dice, are fond of maintaining the that the abandonment of India by the would increase the power and resource country. What is morally wrong, they a never be politically right; and they are oc vexed with such uneasy questionings of as to the justifiableness of England's c holding a foreign country in subject they eagerly ascribe to it all kinds of e quences. Their way of thinking in this like that of a distinguished Envoy fro who on his voyage to Europe asked the

ular and Oriental steamer in which he senger to spread out before him the map rld, and show him what territories be- England, and who, after having had our ad dependencies in Europe, Asia, Africa, and Australasia pointed out to him, held ds in amazement, and exclaimed, "Well, ished that Heaven does not inflict some nishment on such a nation of land

But they believe that our insatiable ew possessions has brought with it its shment, and that, while England has dia materially by dragging her to the bankruptcy, India has, in her turn, ed the English people, by infecting them se desire for power and glory, instead of ve of liberty. Probably many Anglo- icials, after reading in some impassioned the mischief of keeping India, a fervid n of their own pernicious influence in g English society, must have been able to hat Warren Hastings felt when, at the Burke's speech for the prosecution, ial at Westminster-hall, he said he was l he must have been a great villain, e never knew it before. The only con- they can have is in the reflection that these e, for the most part, written by young men, mbition to win a name as philosophical ds them to seize upon a taking subject, ch they have no practical acquaintance, and gloomiest pictures of the disastrous effects h rule in India are painted by persons e never set foot in that country, and who tle or no acquaintance with the real cha- f the English civilians and soldiers by whom erned. What wonder is it if the extrava- nd unfairness of such attacks excite a nt and sometimes unreasoning opposition, irritated Anglo-Indian officials set their one man against outside criticism, and vie e another in emphatically asserting that s the best of all possible administrations? e have, on the one side, high-flown rhetori- cism which overshoots its mark, and, on the prejudiced determination to defend, at all system of government in which the candid r cannot fail to detect numerous imperfec- My aim this evening—and I do not conceal self the hazard I run through interfering tral in such a quarrel—is to steer a middle etween these two extreme parties, and, tempting to give you good reasons for ing the doctrine that English rule in India purely mischievous results, to offer some criticisms on administrative defects, the of which is denied or overlooked by ptimists.

ardly necessary to insist upon the obvious gains which accrue to England from ession of an Eastern Empire. A simple tion of them will suffice. In the first is no slight advantage to us that the ent of India disburses in this country 3 millions sterling a year, out of the collected from Indian taxpayers. The nation, it is true, does not take this money e people of India without giving them g in exchange for it. The amount of the arges represents the value of munitions of war, commissariat stores, and railway materials sent out to India, interest on English capital invested in that country, and payments for skilled English labour employed in the Indian civil and military services, or in the construction and superintendence of public works. But, for a country which has a good deal of capital and skilled labour to spare, as England has, it is an unquestionable advantage to find such safe, constant, and profitable means of investment; and we have only to contrast the security enjoyed by the holders of Indian bonds, and the public servants of the Indian Government, with the anxieties and losses endured by Englishmen who have trusted in the good faith of other Eastern States, to get a measure of the pecuniary worth of our imperial supremacy. But the home charges only show the direct transactions between the Governments of England and India. The indirect gains of private enterprise in India are also very considerable. British India ranks now with France, Germany, and the United States among our very best customers. The United Kingdom supplies her with three-fifths of her whole imports of merchandise; and, while there were not wanting a year ago prophets of evil, who exulted over the falling away in the Indian trade, consequent on the famine of 1878, as evidence of the accuracy of their gloomy forebodings, and who predicted that it could never revive, but must continue to decline, it is satisfactory to observe that there was an immediate rebound after the good harvest of 1879, the imports of merchandise, in the year ending March 31, 1880, having exceeded those of the preceding year by more than three millions sterling, while for eight months of the present financial year, April to November, 1880, not only was this re-action maintained, but the imports of merchandise increased in value to 32 millions, against 24 millions in the corresponding period of 1879, showing a further rise of 25 per cent. Nor do Englishmen make profits only on the import trade into India.*

* Trade of British India, exclusive of Government Stores and Treasure, on account of Government.

	Year ending March 31, 1879.	Year ending March 31, 1880.
	£	£
Imports:—		
Merchandise	36,566,194	39,742,166
Treasure	7,056,749	11,655,395
Total	43,622,943	51,397,561
Exports:—		
Merchandise	60,893,611	67,173,158
Treasure	3,895,545	1,928,828
Total	64,789,156	69,101,986
Total Imports and Exports, Private Trade ..	108,412,099	120,499,547

Eight Months, April to November, 1880.

Imports:—	
Merchandise	£32,069,340
Treasure	6,462,616
Total	£38,531,956

Exports:—

Merchandise	£44,306,012
Treasure..................	1,036,127
Total	£45,342,139
Total Imports and Exports for eight months of 1880-81	£83,874,095

STATEMENT SHOWING THE AMOUNT OF BILLS DRAWN ON INDIA DURING THE FOLLOWING PERIODS, AND THE SUMS RECEIVED IN RESPECT THEREOF:—

Period.	Bills Drawn.	Sum Received.
	Rupees.	£
1878-79	169,123,612	13,948,565
1879-80	183,500,000	15,261,810
1880.		£ s. d.
April..........	21,500,000	1,786,783 1 10
May	14,000,000	1,167,621 2 0
June...........	16,500,000	1,387,041 2 11
July	12,000,000	1,009,572 18 7
August........	12,000,000	1,011,406 5 3
September	15,000,000	1,254,122 19 3
October........	12,000,000	1,000,270 16 10
November......	12,000,000	990,078 3 1
	115,000,000	9,607,596 9 9

The greater portion of the export trade from India is also controlled by English houses, settled in the Presidency towns; and four-fifths of the shipping engaged in the foreign commerce of India belong to British owners. If you trace the history of a bale of Indian cotton, exposed for sale in the Liverpool market, you will probably find that in all its successive stages, after being grown and picked by the native cultivator, it has been made ready for and brought to the market by English capital and labour. An English agent has selected it in the producing district; it has been carried down to the sea-coast by a railway company working with English capital; an English mercantile firm in Bombay has pressed it, and sold the bill of exchange against it through an English broker to an English bank; and it has been transported from Bombay to Liverpool on board an English steamer. So, again, with regard to the piece goods trade from this country, it is entirely financed and managed by Englishmen till the bales pass into the hands of the native dealers in the bazaar of Bombay. You will readily calculate how many different profits this vast trade, which may be valued at a hundred millions sterling, yields to all these classes of English manufacturers, merchants, bankers, middlemen, shippers, engineers, and other mechanical experts. And when you add to such mercantile gains the private remittances sent home by English tradesmen and professional men settled in India, and by the civil and military servants of the Crown, you can realise how immense, in the aggregate, must be the contributions which our great dependency annually makes to the wealth of England. There is not a town, it may be said without exaggeration that there is not even a hamlet, in this country in which the fructifying influence of the capital thus acquired is not felt, although it may not be *always recognised*; and I do not know any industry

in the United Kingdom, small
would not suffer loss, if the conn
were broken off. But, it may be
able trade with India would rem
country became independent. I d
remain. The preference for indi
taxation, which is common to all
enlightened nations, and which
by many Englishmen, is on
in India by the authority of the I
ment; and, if this were onc
natives would speedily raise a lar
the State revenue by levying pro
duties on piece goods and other E
dise, and would injure our car
granting bounties to native
impress, too, of English civilisatic
modifying native customs and mai
cities at least, and creating a taste
and refinements of European life
effaced, and a limit thus set to
tension of our trade in the East
conclude, therefore, that the mat
England are bound up with the
our Indian Empire. Whether or
sion of empire is morally b
citizens of a free State is a more
putable question. It is many yea
republican virtue of Professor
took alarm at the liking for arbi
which he detected in the large and
of retired Anglo-Indians. So far,
own experience goes, I think I
Anglo-Indians generally hold ve
about matters of domestic policy
are rather inclined to make lig
troversies about franchises and
which, if we are to believe excit
cians, periodically bring this
brink of a revolution. It is quite t
hand, that Anglo-Indians are, pe
Imperialists in the best sense of th
term; and possibly in the preser
public mind, it is not to be regrett
infusion of Imperialism should
England year by year, from h
dependencies in all parts of the
imperial instinct is always active
vigorous nations; it is nowhere
energetic than in the United Sta
and an observant companion of G
his recent voyage round the wor
Indians what he took to be the hig
remarking that, in their political
seemed to him to resemble Americ
Englishmen.

I pass now to the considerati
difficult branch of my subject—th
on the fortunes of the people o
land's relations with that country
that the alliance between the
mutually advantageous, or are
of it enjoyed by one, while th
the loss, not only of its politic
even of the legitimate reward
and the natural increase of th
earth? It is not too much to s
believed by many Englishmen—s
of persistent misrepresentation-
brought to the brink of ruin by t

s mercilessly imposed upon her. The phrase, ie Bankruptcy of India," is often used as if it ribed an actual fact, instead of the vision of an wrought and distempered imagination. The sh peace established throughout India is de- to be as baleful as the *Pax Romana* was to some provinces of the Roman Empire; but the re- ad dressed by the Roman historian to his men, *Solitudinem faciunt, pacem appellant,* t apply in this case. England's crime, on trary, appears to be that, under her rule, an population has multiplied too freely for ductiveness of the soil; that the yearly f wealth to England has so impoverished ntry, as to leave no margin of the means of nce stored up against the years of famine recur at regular intervals; and that, conse- ly, when a scarcity comes, the people, taxed e utmost limit of human endurance, perish illions, because they have neither food enough me to eat, nor the money wherewith to pur- e it abroad. English Imperialism is, in fact, are told, killing itself by the exhaustion of its im. Well, this gloomy picture must strike with asement anyone who is familiar with the out- rd signs of the steadily increasing prosperity of dia. Can it be possible that a revenue steady in growth and easy of collection, that populous and wealthy cities, a flourishing foreign trade, the rapid development of many new industries, and a general rise in the standard of living among the labouring classes of the population, which are the accepted marks of well-being in all other States, only con- ceal in India a deep-seated disease which is wasting away the body politic? Let us examine attentively the statistics of trade on which the believers in India's impending ruin chiefly rely. I have already shown you how profitable this trade is to England, but we are told that it must be in an equal degree unprofitable to India, since that country, accord- ing to the Custom-house returns, exports every year twenty millions' worth of produce, for which she gets nothing back. The fallacy of this argu- ment lies in the assumption that the Custom-house returns afford a complete balance-sheet of the transactions between the two countries. To find out what India really gets in exchange for her exports of produce, you must add to her imports of mer- chandise and treasure so many millions for interest on English capital invested in India in a hundred different ways, and so many more for the wages of the skilled English labour employed in her ser- vice; and when these additions have been made to the valuations of the Custom-house authorities, India is found to be no loser by her foreign com- merce.

This conclusion is further borne out by an analysis of the kind of imports she receives. She does not, as a poor country necessarily would do, take back the value of her exports of cotton, indigo, seeds, tea, coffee, and spices in food and clothing for her people. She imports what foreign merchandise she requires, and is paid the balance in gold and silver. Mr. Goschen's Committee of 1876, on the depreciation of silver, calculated that, in the 40 years between 1835-36 and 1874-75, India absorbed, in round numbers, silver to the amount of £200,000,000, and gold to the amount of £100,000,000. The whole of this gold, and probably the greater portion of the silver, were manufactured into ornaments or hoarded. Since 1876, when the opinion generally prevailed that a steady decline had begun in the Eastern demand for bullion, the imports into India have continued on the same scale, and it is not a little remarkable that in the famine year, 1877-8, they amounted to the sum, unprecedented since the era of the American civil war, of more than £15,000,000. Now it is surely preposterous to assert that a country, which is thus shown to be at the present day, as it has been for many centuries, "the sink of the precious metals," can be falling more deeply every year into a state of hopeless poverty.

But, it may be said, granted the unreality of the supposed drain of wealth from India, and that the larger amount of capital now devoted to agricul- ture, and the increased facilities of communication, give her a surplus stock of produce by the sale of which to foreign nations she can steadily enrich herself, still the question remains, if the wealth thus acquired is fairly distributed among the people, and especially among the cultivators of the soil. There must be something rotten in the state of any country in which wealth accumulates in a few hands, while the mass of the population become poorer every day. Now, a very strong opinion has recently been expressed by Mr. James Caird, who, as a great authority on agriculture, was nominated by the late Government a member of the Indian Famine Commission, that, "so far, our success in India has resulted rather in the conquest of vast possessions, than in elevating the individual man." The cultivator is, as a rule, he thinks, the slave of the money-lender. It is not, however, denied that the stock of capital avail- able for investment in agriculture has in- creased, or that there is a steady extension of cultivation. If, nevertheless, the condition of the actual cultivator in some parts of the country has deteriorated, the cause of this decay must be sought in the habits of the people. The tendency of modern trade is to sweep away the middleman, by bringing the ryot, or peasant proprietor, into direct communication with the European markets, and thus enabling him to make larger profits on the sale of his produce; but no change of this kind can permanently benefit small holders, who have no money of their own, who think it a mark of res- pectability to be deep in their bankers' books, and who, by an honourable custom, make themselves responsible for their fathers' debts. The ryots of the Deccan had a magnificent opportunity of making themselves and their families for ever independent of the village usurer during the five years of the American civil war, when the price of Indian cotton was more than quadrupled. But they fancied, as the Bombay Government did, that this exceptional period of prosperity could be maintained; and so, while they, on the one hand, exercised no thrift, the Government, on the other hand, raised their rents, until, in the long period of falling prices which succeeded the American war, their situation became intolerable. The remedy sought by the Government for this state of things is the limitation of usury; but there can be no more grievous economical mistake than, in the hope of averting political mischief, to root an impoverished peasantry in the soil, and drive capital away from cultivation. But Mr. Caird goes on to say that the condition of

"the landless labourer" is still more deplorable than that of the cultivator. "Though wages have risen at the centres of industry, this is not the case in the purely agricultural parts of the country. In such localities the labourer gets the same dole that he got in the last generation. The numbers of such people are increasing, and their condition is becoming every ten years more desperate. Thus, the greatest difficulty with which the Indian statesman is confronted is over population, with constant increase, and his first and main duty will be to carry out a policy under which the people may be enabled to provide themselves with food. An exhausted agriculture and an increasing population must come to a dead lock." Elsewhere he says, "Population is increasing, the price of food is rising, the production of it, as shown by exports, scarcely advances; whilst, as the number of the landless class who depend on wages is constantly growing, the supply of labour, in the absence of industries other than agriculture, must soon exceed the demand. Already their wages bear a less proportion to the price of food than in any country of which we have knowledge. The common price of grain in the Southern States of America, on which the free black labourer is fed, is the same as that of the Indian labourer, viz., 50 to 60 lbs. the rupee. But his wages are eight times that of the Indian, 2s. to 2s. 3d., against 3d. a day, whilst the climate is much the same in its demands for clothing and shelter." The reply of the Government of India to this formidable indictment is an admission that "the population of some parts of India is very dense, especially in the Ganges Valley, from Saharanpur, in the north-west, to Tipperah, in the south-east," and that it is "in some parts, already too thick for the country and its produce." At the same time the Government maintains what, in face of this admission, would seem to be the paradox, that wages have risen in India during the last 20 years. The wages of skilled labour of all kinds have risen considerably, but even the wages of rural labourers show a distinct improvement." Dr. W. W. Hunter, in his recent lectures, seems to take almost as unfavourable a view of the case as Mr. Caird does. Speaking of the increase in numbers of the inhabitants of British India, he says:—

"The average population is now 211 to the square mile. How thick this population is may be realised from the fact that fertile France has only 150 persons to the square mile; while even in crowded England, whereever the density approaches 200 to the square mile, it ceases to be a rural population, and has to live, to a greater or less extent, by manufactures, mining, or city industries. Throughout wide districts in India, each acre of land has to feed a human being for a year. In certain smaller areas of Bengal, two persons have to live on the produce of each cultivated acre, or 1,280 persons to the cultivated square mile. We speak of the poverty and the miserably small farms of the Irish peasant. Well, Ireland has, according to the last census, 169 persons to the square mile. But we can take 13 districts of Northern India, equal in size to Ireland, which have to support an average of 680 persons to the square mile, or over one person to each acre."

I venture to protest against the tone of exaggeration which pervades criticisms of this sort. The *average population of* Belgium to the square mile is 451; of England and Wales, 389; of 377; of the Netherlands, 291; of the empire, 289; of Great Britain and Irela of Wurtemberg, 249, and of Italy, 237. therefore, is very far from topping the Germany, with a population of 193 to th mile, treads very closely on her heels. superabundant population of India is mai found in the broad valley of the Lower which possesses a soil of unrivalled fertilit capable of maintaining probably twenty t population that could live upon an equa territory in the German Empire. Dr. declares that, "after a minute comparis condition of the Bengali peasant in our o with the facts disclosed in the old m records, he is compelled to the conclus throughout large areas, the struggle fo harder than when the country first passed hands." I hope he will publish the eviden appears to him to justify this conclusion opinion of employers of labour in other India is that the Bengali is, as a rule, de the inducements to emigration held out because he is, on the whole, tolerably well with his lot. His wants are few and easi plied; and when Mr. Caird contrasts h dition with that of the free black labo America, he forgets that Indian coolies have under native no less than under British ru accustomed to do a comparatively slight of daily labour for wages which they can li but which would hardly keep body a together in any other country in the worl indignation which is sometimes felt by Eng when they hear that in India the labourer at the rate of 4d. to 6d. a day is quite mi By religion and custom, all classes of Hin as a rule, wonderfully abstemious; and the painted a hundred years ago of the Pei head of the Mahratta nation, sitting on ho with his spear stuck in the ground by h and making his dinner off a handful of grain, represents no extraordinary incide the usual way of life of all the Mahratta prince to peasant. Possibly, even the rural labourer, earning his 12s. to 8s. a we compelled to live on animal food and stron and to buy plenty of warm clothing, unable at all times to guard himself agai and hunger, might envy the Indian coo his 4d. a day, who can be content with his rice or grain, and with, perhaps, only a ra his loins, is secured by his genial clima knowing what is meant by the cold, whic worst enemy of the poor in Northern One thing that usually escapes notice is th of the general employment of Indian wom children in out-door labour. This custom the nominal rate of wages of the men, w the same time, it may treble or quadr earnings of each family.

The whole controversy about over-po resolves itself into this question:—Are t of wages relatively higher or lower in pr to the prices of food-grains than they we twenty years ago? It is unnecessary to g back in our inquiry, because, if the p exhaustion is really going on in India, to be more plainly visible in its later

ges. The elaborate report of the Famine on contains no exact information on the and, while some of the Commissioners ly assert that the economical condition of ry is, on the whole, improving, others ly dissatisfied with it. As the evidence the Commission has not been published, no means of estimating the comparative these conclusions. I have thought, theret it might be worth while to collect infora the subject from independent sources, have received from Mr. Middleton, a h the firm of Messrs. Glover and Co., the wn railway contractors, and, I should he largest employers of labour in India, a paper embodying the results of his many perience in the North-West and Central s. He says:—

ห-West Provinces.—I am of opinion that ges of labour in general have increased to ent of an average of 33 per cent.; some some less, but that the largest increase has the price of the common coolie labour. The for this are various:—1. Increase of work, ent on the country being opened out by s, &c. 2. Increase of acreage under cultivation. ase of various industries, such as cotton and ills, the tea industry, and similar highly cultiroductions opened out by Europeans. 4. The cost of food caused by the facilities of drawing the sea-ports for exportation of all surplus Skilled labour has undoubtedly not made the hat the ordinary working or coolie labour has nd this I attribute to a larger number being very year as artisans—to my knowledge ryots cated their sons as masons, carpenters, &c. I it although population has slightly increased in lecade, the average of grain food raised has in decreased. The country has passed through ears of under-average crops, but in the history and other countries such visitations have been mmon. They were far more severe in their ancient times, through the want of informameans of transit for food, but that the country ow overburdened with population is what no ately acquainted with these provinces would o far from such being the case (I speak from sonal experience), it is now much more diffillect a large number of labourers on earthich is the labour-key in this country) than at much enhanced rates, although they are d better. The working man is more indefew are dependent for their daily food on the mouth system, and I consider that the largely use of railways, as means of moving long shows an accumulation of wealth which did previously. Now, such accumulation could resulted from a smaller increase in the price an of wages, and the price of food is a sure of the too dense or meagre population of a

al Provinces.—Here there has been a large the population, but not nearly in proportion to se of cultivation, and to the increase of returns Nowhere in India have the people bettered tion in the last ten years more than in this Grain is certainly somewhat dearer, through ties given by the Great Indian Peninsula or exportation, but wages are quite 50 per er, through the agricultural population having by increase of food-grains. Vast tracts yet be brought under the plough, and these could support several millions more than they while district officers are doing their utmost to import labour from the (so called) teeming population of Bengal and the North-West Provinces, the fields sigh in vain for the rural population they hold out such rich attractions to. From the above considerations, I am of opinion that, apart from increased skilled cultivation, India can yet feed on its present production a population greater than now depends on it."

Mr. Glover himself writes:—

"In the North-West Provinces and Rajputana, where I have been engaged in making railways since 1872, labour has not only risen in value by about 50 per cent., but it has become scarce in proportion, this scarcity being, no doubt, caused by the increased demand for labour on the fresh land taken into cultivation, and by the gradual extension of railways. Wherever a railway is made, labour at once increases in price very much, and has never again receded to the price paid when a line was first started. In Bombay itself labour has certainly increased in price from 30 to 50 per cent. during the past ten years."

This statement with regard to Bombay is confirmed by my own experience of the rise in the wages of domestic servants, and labour of all kinds, in the Presidency town, at all events; and one cause assigned for the deterioration in the quality of the recruits for the Bombay army of late years is that the soldier's pay, once thought very liberal, is now less than the wages which can be earned by the same class of men in civil life. A gentleman, who has had great experience in letting contracts for large works in and near the city of Bombay, writes to me:—

"In 1868-69 the rates for coolies on the roads was from 3 to 4 annas a day, it is now 5 annas. Two to 3 annas was the charge for women coolies, now the charge is 4 annas. The rates for skilled labour in 1869, as compared with those now paid were, a good mason, 8 to 12 annas, now R.1 to R.1 4 annas a day; carpenters, 8 annas, now 12 annas to R.1."

In the rural districts of the Bombay Presidency, of course, the change has not been so marked. My friend, Mr. John Gordon, the secretary of the Bombay Chamber of Commerce, whose masterly papers on financial and economical questions are familiar to all persons interested in Indian affairs, has taken much trouble to supply me with tables, showing the variations in the prices of food and of skilled and unskilled labour throughout the different districts of the Bombay Presidency during the last ten years. These tables are printed on three following pages. I may say generally that they show very remarkable changes in the prices of food, while the rates for skilled labour have improved considerably in most districts, and those for unskilled labour have either remained stationary, or slightly increased. The food grains of Western India, jowari and bajri, are kinds of millet which are never exported, and which, therefore, are quite unaffected by the development of the trade with foreign countries. Their price varies with the more or less propitious character of the rainy season. Thus, in December, 1877 (a year of famine), only nine seers of jowari could be bought for a rupee in one of the rural collectorates, while, in December, 1880, 29 seers could be bought for the same money. The lot of the labourer, whose wages remain stationary, is, therefore, good or bad according to the abundance or scarcity of the seasons; and the evidence

STATEMENT OF THE PRICES OF FOOD GRAIN AT THE HEAD-QUARTER STATIONS IN BOMBAY PRESIDENCY.

QUANTITIES PER RUPEE BY SEER OF 80 TOLAS, OR 16 CHITAKS.

	Ahmedabad.		Kaira.		Panchmahal (Godra).		Surat.		Broach.		Khandeish (Dhulia).		Nassik.		Thana.		
	Jowar.	Bayree.	Jowar.	Bayree.	Jowar.	Bayree.	Jowar.	Bayree.	Jowar.	Bayree.	Jowar.	Bayree.	Jowar.	Bayree.	Jowar.	Bayree.	Jowar.
	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.
1877.																	
January	18 8	14 6	16 13	13 15	21 4	16 0	11 10	11 7	13 14	13 5	16 0	14 12	16 1	12 11	13 9	10 9	...
February	19 0	14 0	16 0	13 10	20 0	15 4	11 13	11 10	15 4	13 5	15 11	13 12	15 14	12 11	11 5	10 9	...
March	15 0	13 8	16 0	13 10	20 0	14 8	12 12	12 1	16 0	13 5	17 3	14 5	15 6	12 11	11 1	10 9	...
April	15 2	13 1	16 0	13 15	18 10	14 8	12 3	12 9	13 4	12 13	15 14	14 4	15 6	12 11	10 14	10 9	...
May	14 7	12 1	12 13	11 14	14 14	13 0	12 0	11 7	12 13	11 4	14 12	13 8	13 4	11 8	10 10	10 9	...
June	14 7	11 0	12 6	11 7	12 11	11 10	11 3	11 10	12 5	10 10	13 14	12 12	12 9	11 5	10 0	10 5	...
July	12 8	10 12	11 7	11 6	13 5	12 1	9 4	9 7	10 8	10 7	12 10	11 7	10 8	9 10	8 3	8 6	...
August	8 8	7 12	7 14	6 7	10 10	9 5	7 14	8 4	8 0	8 0	9 2	8 12	9 1	7 6	7 11	7 10	...
September	7 4	7 12	7 2	7 4	9 5	7 10	8 14	7 13	7 10	8 13	8 13	8 9	9 9	7 9	7 1	7 10	...
October	9 0	8 8	9 3	8 4	8 14	7 4	9 11	9 4	9 2	8 11	10 10	9 10	13 4	9 2	7 1	7 10	...
November	9 8	9 12	10 11	8 10	9 10	7 4	9 9	9 4	10 0	8 10	14 4	11 11	13 9	10 5	7 6	8 0	...
December	10 8	9 8	10 0	9 0	9 4	7 4	11 3	9 4	10 11	8 14	14 6	11 11	15 4	10 7	7 14	8 5	...
1878.																	
January	10 0	9 0	9 11	8 7	10 0	7 4	10 7	9 2	10 0	8 10	14 9½	11 12	13 10	9 14	8 8	8 5	...
February	10 0	9 0	9 4	8 10	9 6	...	9 12	8 3	9 6	8 3	12 8	11 0	11 13	9 2	8 8	8 5	...
March	10 0	8 8	9 11	8 10	8 6	7 4	10 4	8 7	9 11	8 0	12 0	10 11	11 3	9 0	8 8	8 5	...
April	10 4	9 4	10 0	8 14	8 6	7 4	10 15	8 11	10 8	9 2	12 7	11 5	12 6	9 11	8 8	8 5	...
May	10 8	9 8	10 0	8 14	8 14	8 0	10 12	8 7	10 5	9 6	13 6	12 1	11 0	10 6	8 2	7 15	...
June	10 4	10 0	10 0	9 2	8 10	7 9	8 3	9 14	10 0	8 14	13 6	12 7	12 0	10 2	8 2	7 15	..
July	11 4	10 8	9 13	9 13	8 7	7 9	10 7	8 11	10 10	10 7	14 9	13 10	12 2	11 9	8 4	8 1	...
August	11 4	10 5	10 5	9 10	8 14	7 9	10 1	8 11	9 6	9 7	15 14	15 2	14 0	12 12	8 15	8 11	...
September	8 12	9 2	8 1	8 5	9 7	7 9	9 6	8 4	9 8	9 2	14 6	12 9	12 0	11 2	8 15	8 13	...
October	8 12	9 0	8 14	8 1	10 0	7 9	9 4	8 7	10 0	9 6	15 4	12 7	12 0	9 15	8 15	8 12	...
November	9 0	9 0	9 7	8 5	10 0	7 9	9 4	8 15	10 0	9 2	16 12	12 10	12 0	11 4	8 15	8 12	...
December	11 0	9 8	9 7	8 10	10 0	7 9	9 4	9 4	10 0	9 4	14 9	11 12	6 0	11 4	8 15	8 12	...
1879.																	
January	11 8	10 0	10 11	9 0	10 0	7 9	9 4	8 11	10 0	9 4	13 12	12 6	...	11 4	8 8	8 5	...
February	11 0	9 8	10 5	9 4	10 0	7 8	9 6	9 6	10 0	9 6	13 13	11 14	...	11 7	8 8	8 5	...
March	12 0	10 0	10 11	9 8	10 0	8 0	9 4	9 11	10 11	10 0	13 14	11 14	...	11 8	8 10	8 10	...
April	13 0	9 0	10 5	8 14	10 0	8 0	8 11	9 9	9 11	10 0	13 14	12 7	...	10 11	9 1	9 12	...
May	13 0	9 8	10 11	8 14	10 0	...	9 8	9 13	9 11	9 13	11 4	11 7	...	9 12	9 2	9 3	...
June	9 0	9 0	10 0	8 14	8 14	8 14	9 9	10 8	9 8	9 6	11 4	11 0	...	9 9	9 2	9 3	...
July	9 0	9 2	...	8 10	8 14	8 0	9 4	10 8	9 8	9 6	11 11	10 7	...	9 14	9 2	9 5	...
August	9 0	10 0	...	8 14	8 14	8 0	9 2	10 4	9 11	9 6	13 5	12 13	...	9 14	9 1	9 3	...
September	8 4	10 8	...	9 7	8 14	7 12	9 0	10 2	9 3	9 6	10 6	10 1	12 0	9 12	9 5	9 11	...
October	8 10	13 8	...	13 2	12 7	9 8	9 3	10 2	9 0	10 11	10 10	10 15	12 0	9 10	9 5	9 7	...
November	14 0	13 0	17 12	14 9	20 0	11 7	9 10	11 4	11 0	12 1	13 11	11 12	12 0	10 7	9 5	9 7	...
December	16 8	16 8	19 6	16 14	26 10	13 5	13 13	13 4	13 15	13 15	14 15	11 12	...	12 0	9 5	9 7	...
1880.																	
January	19 8	17 8	20 0	17 4	26 10	17 0	15 9	14 8	14 14	14 9	14 2	11 13	...	12 4	9 5	9 7	...
February	20 0	18 8	20 0	17 12	26 10	18 8	18 0	16 12	16 6	14 14	14 15	12 11	14 8	11 12	9 5	10 12	...
March	21 6	20 0	21 5	20 0	26 10	20 0	17 8	16 4	16 0	15 10	17 7	15 12	17 0	12 0	11 9	11 3	...
April	23 8	20 2	20 10	20 0	26 10	20 0	18 0	15 8	16 14	16 0	18 10	16 10	17 0	13 7	12 0	11 4	...
May	23 8	19 8	20 10	20 0	26 10	20 0	18 0	15 12	16 0	16 0	18 4	16 4	19 6	13 11	12 0	11 4	14 8
June	21 12	19 0	21 5	18 12	29 1	20 0	19 8	16 0	16 0	16 0	18 11	16 3	18 4	13 5	12 0	11 4	14 8
July	21 6	19 2	21 5	18 13	29 1	20 0	19 5	16 0	16 0	16 0	18 11	16 3	17 13	13 12	12 0	11 4	14 8
August	21 0	19 0	17 12	17 12	29 1	20 0	18 14	15 14	16 0	16 0	16 9	14 12	17 2	13 6	12 0	11 4	...
September	23 0	21 8	19 6	19 6	35 9	22 13	18 4	15 8	16 14	16 6	16 6	14 2	16 7	13 6	12 0	11 4	...
October	25 0	24 8	24 10	20 10	40 0	24 0	18 6	15 9	20 0	18 14	19 19	15 12	18 3	14 10	12 0	11 4	9 0
November	24 8	23 4	26 5	20 15	42 13	24 0	21 8	17 8	20 10	17 12	23 10	17 15	23 1	16 10	12 0	13 14	12 12
December	29 0	26 0	30 8	24 10	50 0	24 0	23 2	17 8	21 5	17 12	26 5	20 4	25 5	17 10	12 0	16 5	13 12

EMENT OF THE PRICES OF FOOD GRAIN AT THE HEAD-QUARTER STATIONS IN THE BOMBAY PRESIDENCY.

QUANTITIES PER RUPEE BY SEER OF 80 TOLAS, OR 16 CHITAKS.

	Ahmednuger.		Belgaum.		Dharwar.		Kaladgi.		Kanara (Carwar).		Poona.		Rutnageri.		Satara.		Sholapore.	
	Jowar.	Bayree.	Jowar.	Bayree.	Jowar.	Bayree.	Jowar.	Bayree.	Jowar.	Bayree.	Jowar.	Bayree.	Jowar.	Bayree.	Jowar.	Bayree.	Jowar.	Bayree.
87.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.	s. ch.
	13 4	12 12	10 4	10 7	9 3	10 0	7 15	...	12 0	10 8	11 6	11 8	11 4	11 11	10 10	10 6	9 14	11 7
	12 0	11 11	10 0	10 8	10 3	10 14	8 3	...	12 0	11 0	11 15	11 8	11 4	11 11	11 12	10 6	9 11	10 9
	11 13	11 11	10 0	10 8	10 2	10 8	7 6	...	11 8	11 0	11 15	11 8	11 4	11 11	10 10	10 0	9 15	11 4
	11 12	11 11	9 0	9 13	8 11	9 6	6 2	...	10 8	...	10 14	10 6	10 5	10 11	9 0	9 3	8 10	9 13
	11 0	10 12	8 0	8 2	8 1	8 12	5 6	...	9 8	...	9 13	9 12	9 1	9 2	8 5	8 6	8 13	9 3
	10 8	10 7	6 14	7 6	6 12	7 0	4 12	...	9 0	...	9 13	9 12	8 12	9 2	8 5	8 6	8 3	8 4
	8 9	8 11	5 1	5 8	4 13	4 14	4 1	...	7 0	...	7 1	7 3	...	7 2	5 11	5 13	6 11	7 2
	6 2	6 10	4 9	4 14	5 4	5 5	3 14	...	7 8	...	6 2	6 7	10 10	5 13	5 15	6 2	5 3	5 12
	6 6	6 12	7 5	7 0	6 7	6 2	5 5	...	9 8	...	8 7	7 10	8 12	5 13	8 0	8 6	6 14	7 13
	9 2	8 14	9 6	8 14	7 11	7 4	6 3	...	14 4	...	9 4	9 3	10 0	5 13	10 10	11 10	8 0	13 8
	11 0	10 10	15 12	15 0	12 0	13 12	7 10	...	16 8	...	10 14	9 3	10 0	5 13	10 10	11 0	8 6	13 5
	11 12	12 2	16 2	14 13	17 8	17 8	8 13	2d. sort. 15 3	14 0	...	10 14	9 3	11 4	7 7	12 10	13 9	9 4	12 14
	12 10	12 10	15 11	14 11	18 15	16 10	15 9	16 12	14 4	11 0	10 14	9 3	10 0	8 7	13 5	13 9	8 10	10 12
	11 5	11 14	14 2	14 14	...	...	15 4	15 5	14 0	11 4	9 13	8 10	11 4	8 4	11 10	12 2	10 9	11 0
	9 7	9 11	12 11	12 12	14 0	14 0	13 0	13 7	13 8	...	9 13	8 10	10 0	7 13	8 5	8 11	10 3	10 9
	10 2	10 7	12 15	12 13	12 0	12 0	14 8	15 2	11 0	...	9 13	9 3	10 0	8 2	9 2	8 9	10 0	11 0
	10 2	10 6	11 0	11 0	8 2	...	9 8	10 11	11 0	...	9 13	9 3	10 6	8 14	8 13	8 12	10 12	11 13
	9 5	9 11	9 5	9 5	8 2	7 9	8 4	8 8	9 0	...	9 13	9 3	...	8 6	8 0	8 4	8 13	10 7
	9 7	9 13	9 2	8 11	7 10	7 9	8 6	8 4	9 0	...	10 5	10 5	9 3	8 6	8 5	8 5	8 9	9 4
	10 13	11 9	9 15	9 14	8 12	8 10	10 12	10 2	9 0	9 0	10 14	10 6	9 1	8 8	8 5	8 14	8 8	9 3
	10 6	10 12	12 1	11 3	10 13	10 10	13 0	13 4	9 0	9 0	9 12	9 3	9 1	8 8	7 10	8 2	7 12	8 12
	10 3	10 3	12 5	11 10	9 8	8 0	...	...	9 0	...	10 5	9 12	...	8 4	7 11	8 4	7 6	8 12
	10 13	11 10	12 2	12 5	12 0	12 0	15 14	16 14	9 0	...	10 5	9 12	...	7 15	8 0	8 9	8 6	10 13
	10 14	12 4	14 11	14 0	19 0	17 0	18 8	17 6	9 12	...	10 14	10 6	4 8	7 10	8 0	8 14	9 2	11 15
	9 14	11 14	14 4	12 15	15 0	14 8	14 6	13 4	10 0	11 0	10 14	10 1	...	8 8	8 3	8 15	8 15	11 9
	11 10	12 13	12 13	11 11	13 0	11 8	12 14	11 6	10 0	10 8	10 14	10 1	9 2	8 8	8 15	8 13	9 6	11 4
	11 12	11 12	11 13	11 8	14 0	11 0	13 7	12 10	10 0	10 8	10 14	10 6	9 2	7 10	9 5	8 13	9 2	11 4
	11 5	11 9	12 7	12 12	...	...	12 0	11 13	10 0	11 0	10 14	10 6	10 6	8 9	8 13	8 10	9 5	11 11
	9 10	10 0	9 8	10 0	10 0	11 4	10 2	10 0	10 0	10 8	9 4	9 3	10 1	9 4	7 8	7 9	8 5	10 9
	9 8	10 1	9 6	10 3	11 0	8 0	9 10	9 12	9 8	...	8 11	9 3	...	8 4	7 8	7 7	8 11	10 5
	9 12	10 2	9 12	10 8	11 0	10 0	9 13	9 13	10 0	...	8 11	9 3	...	7 6	8 0	7 13	9 2	11 4
	10 8	11 1	10 2	10 8	13 8	12 0	12 11	11 10	10 0	...	9 8	9 3	...	7 6	8 1	7 12	9 4	12 11
	10 3	10 5	11 0	11 0	15 0	14 8	10 15	10 9	10 8	...	9 4	9 3	...	7 6	7 6	7 9	10 9	12 4
	10 8	11 3	12 0	11 11	15 0	15 0	11 15	12 9	11 0	...	10 14	9 12	...	7 6	8 0	8 3	10 5	12 6
	11 0	11 13	13 12	13 6	16 0	18 0	18 8	18 0	10 4	...	10 14	9 12	...	8 4	8 13	8 14	11 8	13 10
	11 6	11 9	17 8	15 14	19 8	21 0	22 4	20 9	11 8	...	10 14	9 12	12 0	10 6	9 0	9 1	10 10	13 6
	12 15	11 11	16 14	17 13	21 0	20 0	20 13	18 11	14 4	13 0	11 6	11 7	12 0	10 6	9 5	9 6	12 15	13 8
	14 0	11 14	17 8	15 10	21 0	19 0	21 2	20 0	13 4	...	12 8	12 1	13 0	9 13	10 7	10 0	16 1	16-10
	14 11	13 4	17 9	16 2	21 8	18 0	21 8	21 1	13 8	...	15 4	12 10	13 0	9 13	10 12	9 6	17 1	15 13
	14 14	13 9	17 8	17 8	22 0	18 0	21 14	21 5	14 0	...	15 4	12 10	13 10	10 7	11 15	9 1	18 8	16 5
	15 11	13 6	17 8	18 0	22 0	18 0	20 10	20 9	14 8	11 0	15 4	12 10	14 5	10 7	11 11	9 11	19 0	16 2
	14 10	13 11	17 2	18 2	22 0	18 0	21 0	20 12	14 8	12 0	14 2	11 8	14 5	10 7	11 14	10 6	18 9	16 9
	15 5	13 7	17 4	19 0	22 0	18 0	24 4	22 8	14 0	11 8	15 5	12 12	13 0	10 7	12 5	11 0	19 0	16 12
	15 1	13 3	16 12	19 8	22 8	18 8	25 10	25 11	13 0	11 8	15 4	12 1	...	10 7	12 5	11 5	19 6	18 2
	15 9	13 6	18 4	19 5	25 0	21 0	21 3	26 8	13 0	...	15 4	12 1	13 0	9 7	12 2	11 9	19 0	17 0
	18 6	17 1	21 11	22 2	29 0	21 0	34 5	30 12	16 0	...	17 6	14 15	15 3	11 10	13 11	12 13	23 4	21 13
	23 12	21 1	25 0	22 9	34 0	21 0	32 5	29 15	17 8	...	24 9	16 10	16 13	12 13	16 11	15 17	28 7	27 0
	24 7	23 2	24 0	23 11	34 0	21 0	34 5	35 0	20 8	...	21 12	18 6	16 14	13 7	17 12	17 9	29 5	29 0

STATEMENT OF THE PRICES OF LABOUR PER DIEM IN THE DISTRICTS OF THE BOMBAY PRESIDENCY.

Labour.	1871-72.	1872-73.	1873-74.	1874-75.	1875-76.	1876-77.	1877-78.	1878-79.	18[illegible]
Ahmedabad :—	R. a. p.	R. a. p.	R. a. p.	R. a. p.	R. a. p.	R. a. p.	R. a. p.	R. a. p.	R.
Skilled	10 0	10 0	12 0	12 0	12 0	12 0	12 0	12 0	
Unskilled	3 0	3 0	3 3	4 0	3 3	3 3	3 3	3 3	
Kaira :—									
Skilled	10 0	10 0	6 to 10a.	6 to 10a.	6 to 10a.	6 to 10a.	6 to 8a.	6 to 8a.	[illegible]
Unskilled	4 0	4 0	3 to 4a.	3 to 4a.	3 0	3 to 5a.	3 to 4a.	3 to 4a.	[illegible]
Panchmahab :—									
Skilled	10 0	9 4	9 4	7 0	8 0	7 1	6 10	7 3	
Unskilled	3 0	2 8	2 8	2 9	2 9	2 6	2 5	2 4	
Surat :—									
Skilled	8 0	7 0	10 0	8 0	8 0	10 0	8 8	8 0	
Unskilled	6 0	4 0	5 0	4 0	4 0	5 0	4 0	4 0	
Broash :—									
Skilled	12 0	12 0	10 4	10 3	9 2	10 0	8 0	8 0	
Unskilled	4 0	4 0	4 0	4 0	3 10	4 0	3 3	3 0	
Khandeish :—									
Skilled	13 9	13 6	10 8	10 4	10 4	10 4	8 0	8 0	[illegible]
Unskilled	3 8	4 0	3 9	3 7	3 7	3 7	3 0	3 3	[illegible]
Nazik :—									
Skilled	14 0	12 0	14 0	12 0	12 0	10 0	10 0	12 0	[illegible]
Unskilled	4 0	4 0	4 0	3 0	3 0	3 9	2 3	3 0	
Thana :—									
Skilled	1 0 0	1 0 0	8a to R.1	8a. to R.1	8a. to R.1	8a. to R.1 8a.	8a. to R.1½	8a. to R.1½	8a.[illegible]
Unskilled	4 0	4 0	2 to 6a.	2 to 6a.	2 to 6a.	2 to 7a.	2 to 5a.	2 to 5a.	2[illegible]
Koloba :—									
Skilled	10 0	10 0	8a. to R.2	8a. to R.2	8a. to R.2	8a. to R.2	8a. to R.2	8a. to R.1½	8a.[illegible]
Unskilled	4 0	3 9	3 to 4a.	3 to 4a.	3 to 4a.	3 to 4a.	3 to 4a.	3 to 4a.	3[illegible]
Ahmadnugar :—									
Skilled	12 0	12 0	up to R.1	up to 12a.	up to 12a.	9 4	9 0	8 6	
Unskilled	3 0	3 6	4 0	up to 4a.	up to 4a.	up to 3a.	up to 3a.	2 6	
Belgaum :—									
Skilled	9 0	10 0	10 0	10 0	12 0	8 0	8 0	8 0	
Unskilled	3 6	4 0	4 0	3 0	4 0	3 0	3 0	3 0	
Dharwar :—									
Skilled	10 0	12 0	12 0	8 0	11 0	10 0	8 0	10 0	
Unskilled	4 0	4 0	4 0	4 0	4 0	2 6	3 0	3 6	
Kaladgi :—									
Skilled	12 0	12 6	12 6	12 3	12a. to R.1	12 0	12 0	12 0	
Unskilled	7 6	7 7	7 7	6 0	3 6	2 0	3 0	3 0	
Kanara :—									
Skilled	12 0	14 0	8a. to R.1	8a. to R.1	8a. to R.1	8a. to R.1	8a. to R.1	8a. to R.1	8a.[illegible]
Unskilled	4 6	3 4	3 to 6a.	3 to 6a.	3 0	2 to 6a.	2 to 6a.	2 to 6a.	[illegible]
Puna :—									
Skilled	1 0 0	1 0 0	1 0 0	10 0	10 0	8 0	8 0	8 0	
Unskilled	5 0	4 0	4 0	3 0	3 0	2 0	3 0	3 0	
Rutnagiri :—									
Skilled	8 0	8 0	9 0	8 6	8 3	9 0	8 9	9 0	
Unskilled	3 0	3 0	6 3	3 6	3 6	4 0	3 6	3 6	
Satara :—									
Skilled	1 2 0	1 2 0	4a. to R.1	up to R.1¾	up to R.1	up to R.1	up to R.1	6a. to R.1	4a.[illegible]
Unskilled	3 9	3 9	1 to 4a.	up to 8a.	up to 4a.	up to 5a.	up to 4a.	1½ to 4a.	1[illegible]
Sholapore :—									
Skilled	12 0	12 0	1 to R.1¼	4a. to R.1	4a. to R.1	4 to 12a.	4 to 12a.	4 to 12a.	4[illegible]
Unskilled	4 0	4 0	2 to 5a.	up to 4a.	up to 4a.	1 to 3a.	1 to 3a.	1 to 4a.	1[illegible]

of these figures, so far as it goes, proves that, even in districts remote from the centres of industry, the "individual man," whose interests Mr. Caird wishes us to care for, has not been injured by British rule.

Another conclusion, which seems inevitable from this necessarily imperfect survey of the state of India, is the supreme importance of public works in that country. The construction of railways is *everywhere* accompanied by a rise in the prices of *agricultural produce*, and high prices are a sign of prosperity when the wages of labour incre[ase, as] we find they do, in at least an equal ratio. I[t is] not the want of food, but the difficulty of bri[nging] it within reach of the people in the districts st[ricken] with a dearth, that caused the grievous loss [of life] in recent famines; and the description giv[en by] the late Lord Lawrence twenty years ago of [heaps] of grain rotting on the ground in the Punjab [for] want of the means of transport to markets [and] supplies is still applicable to many parts of I[ndia]. For it is not much to boast of that in the cou[ntry]

ears we have built a system of trunk lines ng over nearly 9,000 miles, in a country as all Europe, excluding Russia. The United add nearly as many thousand miles to their system every year, while we creep along lia, maintaining an enormous and costly shment to superintend the construction of three hundred miles a year. This unwise omy has been endorsed by the Public Works ittee of the House of Commons in 1879, which aly limited the annual amount to be ex- d on railways and irrigation works in India to 0,000; and it has its supposed justification in ate of the Indian finances. We are often d that taxation in India has reached its t limit, and that still the revenue is in- nt to cover the constantly-increasing ex- re. It is a sufficient answer to this state- to say, that the total debt of India on 31, 1879, only amounted to £138,000,000, ch amount £33,000,000 represents capital l in public works, so that the debt against he Government holds no property does not two years' revenue. Without wishing ipate the budget which will be brought next week at Calcutta, I may safely that the results of the present financial astound critics who refuse to believe in city of India's resources, and who imagine nust have been completed by the unfortu- der made last year about the cost of the rar. Nor can it be pretended that the is raised by an oppressive system of The salt tax alone touches the poor; ough it is, in some respects, objec- -as all taxes are—there is no other general consumption which is used in ll quantities as salt, so that the f duty paid by each consumer is infini- As to the richer classes, there is no n which their position as regards the of taxes is more enviable than in India, many years they even, by persistent succeeded in getting themselves exempted ct taxation in any form, while the in- es they pay are quite trifling. This being about Indian finance, I would put it to a largely increased annual expenditure blic works, and especially upon rail- alled for in the interest of the country. ernment, which receives more than 00 a year from the land, to which it the place of a landlord, is bound to lay siderable portion of this revenue in works to increase the productiveness of the soil, ve cultivators improved means of access markets; and such judicious expenditure amply repaid by the consequent rise in and rent of land.

what way should these works be executed, e enterprise, or by the direct agency of ? Lord Dalhousie reconciled the two by joint-stock companies to raise railway nder a Government guarantee; and this worked well, for the guaranteed lines are y built and economically managed, and, y now pay the full 5 per cent. interest, rol exercised by the State in return guarantee prevents the companies using their privileged position by charging excessive rates and fares. But some years ago, when railway traffic was not yet developed, and the State suffered a heavy annual loss from having to make good the deficiency of interest at the guaranteed lines, the Government of India resolved to have nothing more to say to private enterprise, but to make its own railways for the future. It hoped thus to effect a great saving of money; and, to make assurance doubly sure, it determined to change the Indian railway gauge, and construct a system of narrow gauge lines, which would at least be cheap, if they were not so good as the broad gauge lines. This experiment was begun in 1870, and we are now able to assert that it has completely failed. From Mr. Juland Danvers's last report, it appears that about 2,500 miles of State railways had been constructed up to the end of 1879, at a cost of £25,000,000, so that the average cost has been £10,000 a mile, a rate at which private companies could easily have built the lines on the broad gauge. The working of the State lines, again, compares unfavourably with that of the guaranteed lines, the expenses of management forming a much heavier per-centage on the gross receipts, so that the net earnings are only at the rate of about £1 3s. per cent. per annum. Nor is the real cost of these lines fully shown in Mr. Danvers's report. The Indian Goverment, when it determined to construct its own railways, allowed the companies' experienced engineers to leave India by the score, while it founded an engineering college of its own at Cooper's-hill to supply recruits, who go out with all the practical part of their business to learn. The heavy cost of maintaining this college, and the pensions of the engineers trained in it, ought to be added to the charges for State railways. The chief cause, however, of the excessive expenditure on these lines has been the unfortunate decision of the Government to introduce the narrow gauge into India. Surveys were made, and hundreds of miles laid down on this gauge in Northern India, before the military authorities were able to convince the Secretary of State that break of gauge would be a fatal defect on lines intended for use in time of war; and then all this work was suddenly abandoned, and the gauge of the Punjab Northern and Indus Valley lines made uniform with that of the broad gauge system of the rest of India. The only important trunk line which the champions of the narrow gauge have succeeded in keeping in their hands is the newly-opened Western Rajputana Railway, which completes the direct connexion between the seaport of Bombay and the cities of Delhi and Agra; and, with regard to this line, the Governor of Bombay said the other day, on opening it, that it was so inadequate for the traffic, that before many years were over it would have to be taken up and reconstructed on the broad gauge. You can conceive what a blunder has been made with this line, if you will suppose for a moment, that London had no railway connection with Manchester except by a roundabout railway through York, and that, on a direct line being projected, the State insisted on having it built with a much narrower gauge than that used on all the lines in either the north or south of England. Evidently, such a break of gauge would defeat the very purpose the line was intended to fulfil, that of making communication

between London and Manchester quicker and more convenient, and this is exactly what has been accomplished by the Government of India with regard to the line from Bombay to Delhi.

I have insisted on this case at some length, because it illustrates what I take to be the cardinal defects of our administration in India, namely, the grasping love of power which too often distinguishes high officials, their insensibility to public opinion, and their dislike of private enterprise. The members of the Government of India are usually high-minded, able, and personally disinterested men; but, quite unused to freedom of debate, they cannot bear contradiction, and may even, as in the instance I have cited, be betrayed into spending millions to gratify a crotchet, rather than give way to outside criticism. Hence, it is sometimes said with truth, that India is the most theory-ridden country in the world. With the exception of one or two eminent officials, everybody, Europeans and natives, in India, condemned the adoption of the narrow gauge for the Western Rajputana line. The communities most deeply interested sent up to Simla protest after protest, only to have them treated with disdainful silence; the Government of Bombay itself remonstrated as warmly as it dared, till at last it received orders from the Viceroy in Council to say no more on the subject; and so, without excuse, without attempt at justification, this great wrong was done to the political and commercial interests of the country. Then, with respect to the construction of railways generally, any impartial observer can see that it would be better for India if the execution of new lines were entrusted to a number of companies, who would go on with the work rapidly and uninterruptedly, than that it should be left to a Government which cannot but act capriciously, and, therefore, wastefully, since works begun and half carried out are often stopped on account of the outbreak of a war or a famine, or merely out of deference to the prejudices of some new minister. The present prices of Indian railway securities in the English market show that the rate of interest to be guaranteed to the companies need not now exceed that at which the State borrows money itself. But the Government of India has always been jealous of private enterprise, and this jealousy shows no signs of abatement. The enterprise of unofficial Englishmen, hampered as it has been, has done great things for India. There is hardly an article of Indian agricultural produce exported, the trade in which has not been created or developed by English enterprise, and this animated agency has also initiated the cotton and jute mills, and other industries that are now providing diversity of occupation for the labouring classes. Yet what is the reward of these English adventurers, who ought, if properly treated, to become the mainstay of the administration? India is the only part of the British Empire in which the English merchant, planter, professional man, or tradesman is absolutely shut out from having any share in the government of the country. He pays his taxes, and the Government kindly allows him to join a volunteer rifle corps; nay, the compliment is sometimes paid him of asking his advice on legislative measures which affect his interests, and which are afterwards passed into law in utter *disregard* of any adverse opinion he may have expressed; but the Indian t will not suffer him to enjoy a particle o authority, and it compels him to aband of permanently settling in the countr the partially self-governing municipa have been formed in the great citi which unofficial Englishmen have tried their taste for the management of publ the officials keep a firm grip on the reins A prefect is set over the corporation, in leading-strings; and the mode of members is so contrived, that the Gove always find the means of suppressing independence. Mr. Fawcett lately India to English capitalists, as a fair vestment. If he wishes capital to flow India, let him and others interested in tl —no matter to which political part belong—remove, first of all, the political which are so keenly resented by all An outside the official circle. The present ide administrators seems to be to repro the great German historian of Rome h as the political condition of an imperi in which there were no Romans but "ci officers, and schoolmasters." I, for believe that the English Government strike root in India until it h or rather allowed to grow up, a str class leavened throughout by the Engl As a matter of policy, high posts in the tion should be reserved for others th ment servants. In each of the Governments, as well as in the Co Governor-General, the control of the corresponding to the Board of Trade entrusted to men practically conve mercantile affairs; and such appointm Commissionerships of Customs, of municipalities, and of Harbour Boa be regarded as the legitimate reward spirit among non-officials. Nor ca reason why the Railway Department sh be superintended by royal rather engineers. It is a curious circumstan agent of an Indian railway, who, in would never have been thought eligibl in the executive Government, was sel years ago to be the director-in-chief of ways in Egypt. The Egyptian co clearly more liberal than that of the Ind I would finally ask, with reference to of my subject, if a solution of the diffi nected with the maintenance of a Eur in India might not be found in the e men for special service in that countr condition that at the end of a certa years they should receive grants of lan with their families in India. A chain colonies might thus be formed, which w strengthen our hold on the country.

The next best thing to the adoption generous public works policy that co for India, would be the abandonment of her exclusive and selfish policy of join in any attempts to restore the i value of silver as a medium of exch cruelly India suffers through the dep silver will be apparent when you cons the public remittances alone to the Ho

the loss to Indian taxpayers amounts to £3,000,000 a year, and that the effect of a value of the rupee to 1s. 10d. would be a sufficient to cover the occupation of Kanda- But the depreciation of the rupee is also ly felt by private remitters, by the holders ian securities of all kinds, and by owners of rty in India; and, while a low rate of ex- unquestionably exercises a stimulating on the Indian export trade, it has, on the hand, the compensating disadvantage of les- the purchasing power of India as a consumer goods. The monied interest of England to be very shortsighted in refusing to listen complaints of India on this score, and placently declaring that a gold currency is good enough for England, and that other must look after themselves. An able has recently argued, with much force, that ady decline in prices which is still going on gland, and which especially affects land- is the result of the growing scarcity of gold, at that metal has become the only measure national value, and the time may come when in the value of all kinds of property will y affect the purchasing power of England and deprive her of that control of the market of which she is now so proud. while she still can command as much she wants, it might be prudent for her to ought to the interests not only of foreign , but of her own great eastern dependency, end a representative to the Conference to meet at Paris next month to consider means of readjusting the value of silver red with gold.

ails me to speak of the reductions that le in Indian expenditure, but I believe is right in saying that the higher ranks ivil Service in India are too well paid, taken into consideration how few of the ties of exile a residence in India now It is in the home charges, however, that est scope for economy will be found. ase in garrison, and furlough, and ab- owances of late years is quite startling; e military department, in particular, the ct of reforms in the organisation of the ns to be a steady increase in the amount on-effective charges in England. Last amount expended in England for the ay of officers of the Indian service, colonels' allowances, was £1,205,874. Pall-mall and St. James's-street swarm red Indian officers, while the supply of duty with native regiments in India is hort as to reduce many of them to a efficiency. Then the cost of the India- Westminster has increased, is increasing, t to be diminished. It now amounts to of £215,804, against £173,000 in 1865. al business of the Government is done in l only the work of supervision in England, -office ought to be by far the most orked of our departments of State, but it osts as much as the War-office. Its dis- ature is, that it provides for a Council -Indian experts, at an annual cost of without counting the salaries of its staff ries and clerks, to advise the Secretary of State chiefly on matters of finance. The late Mr. J. S. Mill applauded the constitution of this Council as the most successful of modern application of the science of representative government; but experience has shown that it is of very little use, except to provide additional pensions for eminent Anglo-Indians. The House of Commons has practically taken the control of the Indian finances into its own hands; and, after the confession made by the India-office, last year, that it had not the means of detecting or remedying the blunder made in India about the Afghan War estimates, one may well ask what the financial supervision of the Council of India is worth. Surely, it would be better for the country if the Secretary of State could no longer reward a partisan, or silence an adversary, by giving him a place in the Council of India, and if eminent Anglo-Indians, on retirement from service in the East, entered public life in this country, and gave the nation the benefit, in the House of Commons, of the matured advice and criticisms which they now whisper vainly in the obscure recesses of the India-office.

One administrative reform which would certainly have the effect of changing the character of our rule in India I have not yet referred to—I mean the proposal for the more extensive employment of natives in the higher ranks of the administration. The Government of India, in its comments on Mr. Caird's report, declares itself in favour of a change in this direction, and says:—

"We have before us, and have referred to the local governments for consideration, a scheme of recruitment whereby the total strength of Europeans in higher offices might ultimately be reduced to 571 for the whole Bengal Presidency."

I confess that I should look upon the accomplishment of this scheme with great uneasiness, and, indeed, with alarm. To maintain the existing bureaucratic system of government in India, merely substituting native for European agency, would, in my judgment, be a fatal mistake. There would be no economy in such a change, because, unless you paid the natives as liberally as the Europeans, they would be dissatisfied, and the administration would consequently become inefficient and corrupt. Again, European civilians in India have even now too large a body of native subordinates interposed between them and the population. This is one great cause of the want of knowledge of and sympathy with popular feeling, which is often made a matter of reproach against them. Reduce their numbers still further, in order to increase those of native officials, and the English portion of the administration will be left completely in the air. All the machinery of government will be managed by natives, and in troublous times the English raj might be overthrown by official conspirators before the mass of the people knew what was intended. Of course, this may be the consummation desired by those persons who contend that we ought always to be preparing to leave India and to give back the country to the natives. But, though I have known many Englishmen who would talk about educating the natives of India for independence, I have never met one who would fix any date at which this transfer should be accomplished, or who was not ready to vote for spending the last drop of English

blood and the last shilling of English money to prevent such a catastrophe from happening in his day. This talk about India's future independence is, therefore, only the counterfeit coin of a false sensibility. I confess that I do not believe India can ever attain independence. Her people dread leaving their own country and crossing the ocean, and her coasts and foreign trade have, therefore, always been, and must continue to be, at the mercy of whichever power has the command of the seas; and the national character is so unwarlike that, even if Hindus and Mussulmans forbore fighting with one another, they could not hope, without European protection, to resist the inroads of stronger races from the north. England may then, with a good conscience, continue to hold India, if she takes care to act fairly and justly towards the people of that country, and tries to level them up to the enjoyment of constitutional liberties by proceeding cautiously in the path of decentralisation, and steadily enlarging the limits of municipal, and ultimately provincial, self-government, while at the same time maintaining the distinctively English character of the administration, and cherishing to the utmost, instead of endeavouring to efface, the English element of the population. By such a policy we should, I am persuaded, do more good to a country, in whose future I take the deepest interest, than by making it over to the tyranny of a native bureaucracy; and, by persevering with it, we might hand down to our successors our imperial inheritance undiminished in strength and lustre, hoping that from them in turn it would descend to following generations with "better title, better opinion, better confirmation." It should, indeed, be the most ardent aspiration of every true Englishman that, for the sake of both countries, the connection between England and India may never be dissolved; that it may never be said of our native land, in the mournful language of Wordsworth's epitaph on Venice,—

> "*Once* did she hold the gorgeous East in fee,
> And *was* the safeguard of the West;"

but that, for ages to come, England may still retain these proud titles to the admiration and the gratitude of the civilised world.

DISCUSSION.

Mr. Peterson said he had listened with very great interest to the paper, and generally speaking, he agreed with the remarks made in it, but time would not allow him to comment as he would desire upon some of the suggestions it contained. Neither directly nor indirectly would he run a-muck against the authorities who held the government of India. As India had to be governed by us, we must make the best of it, and maintain our rule in the country at all hazards, and at any cost. If England were to desert India to-morrow, and the country were left to itself, more terrible scenes of bloodshed than the world had ever seen would ensue, and India must become the prey of some northern nation, whether Russia or China. Our Cassandras at home were altogether too fond of running down the connection of England with India, but he could testify to the improvement in the country during his own connection with it, as a sailor and as a barrister, since 1829; and if the prophets of evil were better acquainted with *the actual facts*, they would spare many of their utterances. Famine must ever be a visitant o parched under the tropical sun, and dep necessary moisture on irrigation works, respect it could not be gainsaid that Go done its best during many past decade employer of labour in India, he might say years he had hundreds of coolies at wo a day, and the rate of increase in wages the fact that, when he left India, they co at ten pice a day; and as to the value of districts, seventy-two seers, or 144 lbs., wer rupee, while at Patna, a rupee would purch five seers. That was not the case now. said that the condition of India had dete English rule. There were many points in c that rule upon which he could have dilat never been a particular supporter of the Go he would say that, as far as in them lay might have done more, they had ruled In any other country had ever governed a d the question of the grain supply, people wh try was going to the dogs had to recon statements the astounding facts that the w tural labour had very greatly risen, a more grain had been produced the people existed in the country. Trade and c necessities of humanity, and although fr position of traders we had been compel conquerors in India, we must support our extending her commerce. Damage had by our supremacy to the condition of an people, certainly not to the working c general amelioration throughout the c what we had done, let our own Cassandra critics say what they might. Our eff quite as much for our own benefit as fo Anglo-Saxon energy was necessary fo Aryan spirit was simply again flowing arouse the torpor of the Asiatic. Asiatics themselves have started railways, and the them had, in fact, been opposed by the B of the consequences following in their the destruction of caste. The paper was sive in its scope to be fully discussed its publication in the *Journal* there woul ties of commenting upon the topics in A population of some 34,000,000 in the t Hastings had, at the period when Sir G was in office, increased, it was estimated. Such an advance in the numbers of the best test of increased food supplies, the people were better fed. From his the Bengal Coal Company, which wa employer of labour, he could speak perso proved condition of the working popul also, who had any interest in the tea-c how much the price of labour had could, personally, give no information the North-Western Provinces, but wh about the improved condition of the la certainly applied to Eastern Bengal. was going on in India, she was the mos specimen of the process conceivable, increasing population, higher rates larger exports. Excessive taxation w proach levelled at the Government; believe that, at the present moment, th large a revenue over the whole country from it by the Emperors Akbar and Au

Sir James Elphinstone, Bart., said his ac India commenced sixty-one years ago, there was a good deal said about the ac Deccan, and about our territories bein scribed. He had since then made rep had been struck with the extraordinar condition of the native population. He t

the southern parts of India in 1842 and 1846, and on returning there in 1870, was astonished at the great increase in the prosperity of the country. From his experience while in the House of Commons, where he served on most of the Indian Inquiry Commissions, until last year, he was acquainted with the remarkable increase in the rate of wages of the working population, and he had obtained from the Commissariat Department a list of prices, during 20 years, of the articles required for the subsistence of the army. Those returns showed that the increase had actually been from 30 to 60 per cent. in the bazaar prices during that period, and they were to be found in the appendix to the report of the East India Committee, before which he had laid them. His own experience, therefore, thoroughly bore out that portion of the paper.

Sir Joseph Fayrer, K.C.S.I., F.R.S., regretted that the subject generally was one upon which he was ill-qualified to speak, but he would venture to say a few words on the improved sanitary condition of the country, which was a matter more within his knowledge. Certainly in that respect there had been most material improvement during the last half century, as was shown by the fact that the death-rate had been reduced from 50 or 60 per 1,000 fifty years ago to about 15 or 16 per 1,000, by the operations of the Government. Though he was not prepared at the moment to give figures, he believed also that the duration of life among the native population had greatly increased. He could quite confirm what had been said about the improvement throughout the country in other respects. On the question of colonisation referred to in the paper, though he expressed his opinion with great misgiving, and could not very well give exact data for his belief, his own conviction was that the Anglo-Saxon race would never colonise the continent of India. He had, it was true, seen instances of second and even third generations of Anglo-Indians, born and matured in the country, but they always bore about them significant indications of decay. His own belief was that European colonists could never have any permanent existence in the plains and valleys of India, though how far they might be acclimatized in the higher and hilly regions he would not say. That was one of the questions for consideration in the future of India.

Colonel Malleson, C.S.I., agreed with almost every word in the paper, but must make a qualification on behalf of himself and other retired Indian officers, as he demurred to the reference made to unfortunate gentlemen who had nothing to do but to walk up and down Pall Mall. He hoped, by long service in India, they had deserved some provision on retirement, and having returned at last to England, they were able and ready to render further service to their country.

Mr. Russel Aitken, on the subject of public works in India, also agreed with most that had been said in the paper. As Mr. Maclean had pointed out, the break of gauge had not only been a great misfortune but was quite uncalled for, as indeed had been the 5 ft. 6 in. gauge originally fixed. The Indian Government began the railways in a bad way. Instead of adopting a gauge found efficient in other countries, they appointed a Commission of experts to consider the matter, and everybody knew that whenever that was done the experts were sure to go wrong. Experts' opinions were very valuable in guiding practical men; but among themselves they would be led by the most conceited, who was generally the most wrong-headed of all. That was the case in India when the railways were being planned; and three engineers having been appointed as a committee, decided that the 5 ft. 6 in. gauge gave the best results, and that was selected in preference to the 4 ft. 8½ in. gauge, but the 5 ft. 6 in. gauge has been found, after a long trial in other parts of the world also, to be too wide. Then General Strachey adopted the mètre gauge. A railway was wanted up the Indus Valley, and the Governor-General in Council determined that that gauge should be adopted. At Simla, in 1869, he (Mr. Aitken) was asked his opinion upon the matter by a member of Council, and he replied that he thought it was a mistake, but that it was more a military matter than an engineering one. He was informed that Lord Napier was very much against it, but, in spite of this, the result was that the Public Works Department carried their point, and the railway was commenced on that narrow gauge, and had to be altered. And so it was with all the public works. The harbour at Kurrachee was originally designed by an engineer of great experience in harbour construction, but a military engineer, who had ideas of his own, thought proper to stop the works, and so they remained for six years, when the original plans were allowed to be carried out, and the works were found to be eminently successful. Harbour works at Madras, too, which had been attempted to be stopped, but they had lately turned out to be a great success. The fault was not so much that these matters were left in the hands of one set of men or another, military engineers or civil engineers, for men were very much alike, and there were good and bad in all professions; but, in public works, publicity was wanted, and before any works were undertaken, or, at all events, before any money was spent on them, a public inquiry should be opened. At present, these matters were all managed by resolutions in Council, founded on papers, which, if read by the members of Council, he felt pretty sure, would often not be understood by them. Open inquiry, such as was made by the House of Commons upon public works, was what was needed, and that would ensure common sense being brought to bear upon the construction of such works in India. It would be very desirable also to give companies more scope for private enterprise, unfettered by the Government; it was of no use trying to put them in leading strings, as had occurred in the case of the Madras Irrigation Canal Company. The Government should content itself with offering guarantees of so much money per mile on railways, and leave the companies to sink or swim by their own exertions, getting no money if they failed, but if they succeeded, then, so much the better for them. He certainly agreed, therefore, with most of the opinions expressed in the paper, radical as they were on several points.

Mr. Juland Danvers demurred to some of the remarks as to official obstruction contained in the paper, coming, as he did, from the particular hive where the bees were described as receiving too large a share of the honey for unnecessary work. Some of the points touched upon should be adverted to, lest the meeting might be under misapprehension with regard to the desire of the Government upon the question of executing public works through private enterprise in India. Mr. Maclean spoke favourably of the guarantee system, and it had undoubtedly been the means of producing beneficial results to the country. It had simply been adopted for want of a better, and without any idea originally of the control on the part of the Government, which became necessary as soon as they became interested in the returns of the railways. Twenty-five years ago the first attempt was made to assist a joint-stock company in this country to raise money for works in India, but it failed. Efforts were then made in other directions to induce English capitalists to provide money for the construction of Indian railways, but it was found that nothing short of an absolute guarantee would suffice. Within a comparatively short period, under the guarantee system, upwards of £100,000,000 had been expended upon railway works; but at any time the Government would have rejoiced to find that public works required in India would be carried out

entirely by private enterprise. Capital is much wanted in India, and for the erection of cotton and jute mills, and for the opening of coal mines and other industries it has been forthcoming. Many such undertakings were being conducted without any help from the Government, and they might hope that better times were coming in regard to works of public utility, so that before long the artificial and objectionable security of the Government guarantee would not be necessary, in order to attract capital to India. Obstacles would never be placed in the way by Government. Surprise could hardly be felt at some of Mr. Maclean's remarks on the management of the Public Works Department in India, but some excuse could be offered in its behalf in the circumstances in which it was placed. It had been in an experimental stage, and was in a transition state. Such conditions always involved expense, trouble, and difficulty, but it was to be hoped that was now past, and that the success of the existing railways would lead to the introduction of purely private enterprise, which would neither be opposed nor hampered, but heartily welcomed by the Indian Government.

Mr. A. Rogers thought the remarks in the paper on decentralisation suggested the germs of most extensive reforms in the Indian administration; and he sincerely hoped that the attention of statesmen, both in India and England, would be directed to the subject. Until a few years ago, the financial administration was entirely carried on in Calcutta, but the central administration had been considerably relaxed, and more power entrusted to the local Governments in financial matters. People who knew India would admit that that had produced a beneficial effect; and it would hardly be denied that local affairs could be managed better in the provinces than by the central Government at Calcutta, at a great distance. He hoped to see the system still more extended in administrative as well as financial matters, as he believed the people had great powers for self-government. Education was spreading among them, and they were becoming more and more fitted to manage their local affairs.

Mr. J. T. Wood desired to say a few words on the subject of the mètre-gauge railway and guarantee systems. There appeared to be now traffic more than enough on the Indian lines to fully develop the capacities of the metre-gauge, and the time had perhaps come for an alteration of that gauge in some instances. That work would not be very difficult; it had been done on several occasions in America by proper organisation of labour and application of materials, and it had been shown that a great number of miles of railway could be altered in a few hours in that respect. He would venture to say that 100 miles of railway could be altered without stopping the traffic for more than a few days, and in saying so, he would be far within the mark. As to the guarantee system, there was no material difference between that and the actual construction of the railways by Government, because they were making railways with the money borrowed at the ordinary market-rate in England, and they would not be paying less *cæteris paribus* by guarantee, because the rate of interest in England had fallen within the last few years from five to four per cent., at which the Indian Government could borrow any money they required. People might say what they liked, but the difficulty in making railways by private enterprise was that the public had more confidence in the superintendence and check of the Government over such works, than they would have in the promoters of them. Directors of companies might be men of the highest honour and probity, but still people in this country had lost so much money by railway enterprises, that they considered the Government guarantee a check upon even their own selected officers. It had been said that people might make railways anywhere in India if they chose to find the capital for the purpose, but the Acts regulating the construction of railways had to be complied with, and they material Government check on private en could not, under those circumstances, see th investing public in England were concern much difference between the giving of guar construction of railways by the Governm money borrowed in this country. Upon exchanges, he was afraid that any mere currency would not have the effect material difference in the value of the ru from commerce one article of barter would what was wanted was a universal curre Britain and her colonies and depend should be no impossibility, however un greater desideratum of a universal cu whole civilised world might be, for Austral joined in the scheme, and a measure of val as possible, not confined to a single coun should be adopted. Whether the adoption currency would alter the value of silver, different matter, and he had never been stand why these two questions were separately. Another subject which had alluded so, was the recent working of India; and one point of great public int connection with it, was the relative right in the Government, and in private indiv gold fields. If their possession by the exception, he failed to see how the wo could have any great effect on the futur change; and if the property in them bel pally to the Government, that would be a advance towards obtaining a universal Great Britain and her colonies.

The Chairman, in proposing a vote of Maclean, thought the meeting would (the Chairman's) introductory remark, th expect to hear from that gentleman an would be both interesting and eloquent as the representative, to some extent, classes, he could scarcely endorse the entirety, though he thoroughly conc general tenor. It would have been time permitted, that the official side of points should have been fully stated. He very satisfactory to have heard from non- men so much in confirmation of the imp the country; and that, after all, afforded of the official ability with which the a had been conducted. Though not an eng not refrain from adding his own testimon devotion and professional ability wh engaged on public works in India, w service of the Crown or as, in technica engineers, had displayed; and whatever be found with the constitution of the Department, or with the manner in whic had been carried out, the public works stituted a grand record written by England the land, and a worthy monument of Briti scientific skill. Cooper's-hill College, was now being placed on a broader and basis, and it would probably receive would serve their country at home, as destined for service in India. That inst supply a great desideratum for India, nan education. He asked to be excused at from going further into many of the int tions which had been touched upon in a new light upon matters of the greatest inte and Anglo-Indians.

Mr. Maclean, in returning thanks, fu the impossibility of doing justice to so within the limits of a short paper, and better than refer the meeting for furthe

rd Temple's own valuable work, published urn from India. With regard to the observa- public works, and the encouragement of rprise in carrying them out, he believed that ne more cheaply in that way than when exe- e State. Government-constructed railways more costly, both in execution and manage- the guaranteed lines, but at the same time, l was very useful in preventing monopolies arge to the public. He had feared some the paper might be distasteful to Sir Richard t he had full confidence that their Chairman me criticism upon questions of such great , and he would conclude his remarks by pro- t the meeting should join in thanking him kindly presided.

of thanks was cordially passed, and the minated.

TEENTH ORDINARY MEETING.

ay, March 9th, 1881; Lord ALFRED LL in the chair.

wing candidates were proposed for members of the Society:—

ncis James, The Rowans, Lee-road, Lee,

Edward Clive, K.C.S.I., C.I.E., Ascot.

H., Wentworth-house, Manresa-road, W.

illiam, Meadow-head-house, Livesey,

t, 7, Bayswater-hill, W.

lliam Bernard, 54, Regent's-park-road,

dward George, 26, Palace-gardens-terrace, , W.

on-Major G. S. W., 8, Belsize-avenue, , N.W.

el George, 63, Tulse-hill, S.W.

rd, 143, Lewisham High-road, New-cross,

erick Anthony, Kinross-house, Cromwell- , and 85, Gracechurch-street, E.C.

ring candidates were balloted for, and members of the Society:—

omas, Kimberley-house, 2, Evering-road, ington, N.

rd, London, Upper Canada.

, J.P., Ellingham-hall, Bungay.

Robert George, A.I.C.E., Manchester, nd Lincolnshire Railway Company, Man-

., Cornwall-terrace, Penzance.

: read was—

F CHIMBORAZO AND COTOPAXI.

By Edward Whymper.

en invited by the Society of Arts to ture to you upon a journey which I de to the great Andes of the Equator. may perhaps think it strange that any- ected with mountain travel or moun- hould be brought before you; but if you a moment, you will at once perceive of mountaineering is a high art, and is orthy of being encouraged by the p to this time, most of the loftiest portions of the earth are totally unexplored, and this arises principally from the fact that the mountaineer, in addition to experiencing most of the troubles which are met with by other travellers, has to deal with some which are peculiar to his work. I do not now refer to the distressing hæmorrhages, alarming vomitings, and painful excoriations which are said to afflict him. Hæmorrhages and excoriations are rather alarming words, so long as they remain untranslated into ordinary language; but they do not seem to be so very formidable if they are called bleeding at the nose, and loss of skin through sunburn; and it may also somewhat tend to allay alarm, if I say that I have never known cases of bleeding at the nose occur in mountain travel, except to those who are subject to the complaint; while, with regard to vomiting, it has only been known to occur to persons who had taken something to disagree with them. But there is another trouble, which cannot be dismissed so lightly. All travellers, without exception, who have ever attained great altitudes, have spoken of having been affected by another complaint, and this complaint is known to affect even natives of those regions, and persons who have lived in them, as well as casual travellers. This is usually called mountain sickness. There have been numerous conjectures put forward as to its cause; very often it has been supposed to be the work of mysterious spirits, sometimes it has been attributed to weakness, and other causes, but there can be very little doubt that it arises simply from the diminution of atmospheric pressure as one goes upward. At 20,000 feet the pressure is less than half the amount that it is at the level of the sea, that is to say, whereas at the level of the sea the atmospheric pressure is generally capable of sustaining a column of mercury of 30 inches, at 20,000 feet it will not sustain a column of 15 inches. Now, those of you who have witnessed experiments with the air-pump, must know that remarkable effects can be produced by reducing the pressure of air. I well remember the first occasion on which, when at school, I saw an old and shrivelled apple placed beneath the air receiver, and I watched with glee its wrinkles disappear gradually under a diminished pressure, and the apple fill out again, until at length it became as plump as it was in the days of its youth. The effect I then witnessed struck me as so remarkable, that I at once determined to see if I could not recommend its further application, and on my return, home, I suggested that the appearance of my grandfather would be greatly improved if he could be put under the air-pump; but as this application of science to my progenitor caused an application of something else to me, I have ever since regarded myself, in a small way, as a martyr to science. From seeing air-pump experiments, and other purely philosophic considerations, it is obvious that the human system must be liable to derangement, if subjected to sudden diminution of the atmospheric pressure to which it has been accustomed. These depressions have often been so severe as to render mountain travellers incapable, and their lives well nigh unendurable, so it is scarcely to be wondered at that they have endeavoured to escape from the infliction, by descending into lower regions. I do not know of a single instance of a traveller, who

having been afflicted in this way, has deliberately, so to speak, sat it out, and had a pitched battle with the enemy. Nor am I aware that anyone has ever suggested the bare possibility of coming out victorious from such an encounter. Yet upon doing so depended the chance of pushing explorations into the highest regions of the earth, and I long felt a keen desire to know whether my own organisation at least could not accommodate itself to the altered conditions. From considerations which would occupy too long to enter into now, I gradually acquired the conviction that patience and perseverance were the principal requisites for success, and the journey of which I am now going to speak was undertaken with the view of bringing this matter, amongst other things, to a definite issue. In the course of it we camped out at very great heights, twenty-one nights were spent above 14,000 ft. above the level of the sea; eight more above 15,000 ft.; thirteen more above 16,000 ft.; six more above 17,000 ft.; and one more at 19,000 ft. I shall not now anticipate what you will presently hear, but I have made these preliminary observations to render less frequent interruptions of the narrative, and for the purpose of explaining allusions in it which might otherwise perhaps have been only half understood.

Fifteen years ago, when my apprenticeship to the art of mountaineering was finished, and I cast my eye over the map of the world in search of new districts, it was not long before it was directed to the great Andes round about the Equator, they being, perhaps, the mountains of the most exalted reputation, and of great elevation, which still were little known. The highest of the group, Chimborazo, long accounted to be the loftiest mountain in the world, had received the attention of travellers of great celebrity, and in recent years its ascent had been essayed by French, Germans, Americans, and Ecuadorians. All had failed, and each succeeding failure increased the desire I felt to annex it to my own country. To-night I shall speak to you of Chimborazo and Cotopaxi alone, and I select these two mountains on account of the contrast which they afford. The one is capped by eternal snow, and the other burns with perpetual fire. Chimborazo is an extinct volcano, while Cotopaxi is an active one, and is, I believe, the loftiest volcano in working order.

I left Southampton for this journey on November 3rd, 1879, and arrived at Guayaquil on the 9th of the following month. At the time of my arrival, this town was affected considerably by the war between Peru and Chili, and its inhabitants evinced the most impartial desire for the success of both sides. It has been described by previous travellers as a place where there is always something doing, either there is a revolution going on, or an earthquake, or a fire, and this description is fairly accurate; and when I tell you that assassinations were occuring in the streets every day, you will perceive that it is a place well suited to a person of adventurous temperament. Besides this, it may be mentioned that the rivers round about swarm with alligators, and the surrounding land with snakes, many of the most deadly kind. I was not in the town during the wet season, but I am informed that at that time the river overflows the exterior land, and that the non-amphibious vermin in general climb posts and trees, and exhib most extraordinary spectacle. You see hanging by the tail from rails, sitting on t of posts, struggling and writhing in all of inconceivable ways to escape from the while associated with them are scorpions kinds of strange creatures for which scien scarcely a name.

From Guayaquil, we went by a river to Bodegas, and at that place our may be said to commence. My party con two Italian mountaineers (cousins), Jean and Louis Carrel; a Mr. Perrin, whom picked up at Guayaquil, to interpret number of mules and muleteers. The followed was the grand route to Quito, and all the trade from the coast to the interio over it. Its difficulties have been much exagg It is a track, or series of tracks—generall narrow, often very muddy; and there is a co passage of mules, well laden with the most goods. Sometimes "Perrier Jouet" champa found assorted with iron bedsteads; then sheets of corrugated iron laid flat across the of donkeys, or a grand piano carried on the of six or eight Indians. In the reverse direct you have droves of beasts, often 20 to 30 group, coming to the coast, bringing huge bal quinine bark, accompanied by gangs of sham Indians, who, for the most part, are very civil. labourers generally have a good day or a night for the traveller; but, in respect of language they employ to their beasts, I can say that, in comparison, the observations o angry London cabman are decent, and those drunken bargeman are moral.

Three days' travel from Bodegas brought the town of Guaranda, and here I found a po of my heavy baggage, which had been sent some months in advance. This town is 15 in a straight line from Chimborazo, which wa central point of the journey. Many of you probably under the impression that Chimbora often seen from the Pacific. There is an elo passage in Prescott's "Conquest of Peru," scribing the magnificent prospect which it af to the mariner. The fact, however, is that very seldom seen from the ocean. Captains go up and down the coast say that they do no it more than three or four times in 13 or 14 y And, when I tell you that it is distant 91 mil a direct line from Guayaquil, and from that is elevated less than 2° above the horizon, yo form your own idea as to its magnificence from Pacific Ocean, which is 66 miles still farther Up to this time we had not seen Chimbora all. We started from Guaranda on December still continuing the Quito road, and passed the southern slopes of the mountain to see could commence to make out a route which sh promise a chance of success. We came righ the mountain before we saw any part of it, from that day the summit was always envelop clouds. It was obvious we could only go as we could see; so we returned to Guaranda to until the summit was clear. Whilst returning, overcome with dizziness, feverishness, and headache, and had to be supported by two people for the greater part of the way. Imag I was attacked by fever, I took 30 grains of

plate of quinine in the course of the night, and was covered up with mountains of blankets, but next morning there was nothing the matter. As the symptoms were those which occurred at a later period, when we were undoubtedly leaving the low atmospheric pressure, I ultimately concluded that it was through this that my indisposition was caused. At this point, allow me to say a few words further with regard to the troubles which occur to persons who get to great altitudes. Although the heights of the Andes, which we were about to visit, had not been well determined, there was reason to believe that several of them approached, if they did not exceed, 20,000 feet. At the time of our departure there were only three tolerably authenticated instances of persons having reached that height on land, and I could learn nothing which was of the least service regarding the experience of those who were engaged in those expeditions. But from others who had reached altitudes of from 17,000 to 19,000 feet, I heard a confirmation of my supposition that, at such great elevations, I ought not to expect a continuance of the immunity from mountain sickness which I had hitherto enjoyed. I made up my mind, therefore, before we left, that, sooner or later, we should suffer like the rest of the world; but, being of opinion, as I have already said, that patience would overcome mountain sickness, it was my intention, on all our expeditions, first to establish camps as high as we could force the natives and mules; and, as it would be impossible to retain the natives at those positions, it became necessary to provide ourselves with food sufficient for weeks, or even months, so that, in the event of our failing in our enterprise, from badness of weather, mountain sickness, and other causes, we should not have the mortification of being obliged to abandon our positions simply from want of sustenance. And as it could not be expected that we should be able to obtain on the spot the provisions which would keep for such a length of time, I concluded that the only safe course was to make ourselves, from the first, entirely independent of the resources of the country, in the matter of food which should be consumed at the greatest heights. About two tons weight of the most portable and most condensed provisions went out for use, and, irrespective of the things which were bought already tinned, more than 2,000 tins were soldered down. If time would permit, it would be interesting to enter into details respecting our outfit, I must do no more than say that our provisions were arranged in boxes weighing 75 lbs. apiece. Two of them made a mule-load, and each of them held three tin cases, soldered down, each of those three tin cases containing food for four days for one man. They included everything necessary except water and fuel. The preparation of these provisions and the rest of the outfit occupied almost as much time as the performance of the journey, and it appears to me desirable to say this much on the subject, lest any persons who should be tempted to follow in our track should be inclined to doubt our veracity, through finding it impossible to progress with equal rapidity. A great saving of time was effected by arranging the food in this manner, and a small journey was made, which was calculated to occupy two men for four days, I had only to say take ten cases, instead of continually calculating, and then being afraid that candles, salt, or matches might be forgotten.

After two days more, we saw the upper part of Chimborazo for the first time; it appeared to be fine, and so I sent off two guides to select a camping place on the ridge we had examined on the 19th, whilst I completed the preparations for the journey. They returned on the 23rd, very much fatigued, having found a place which was suitable at a height, so it appeared afterwards, of 16,500 feet above the sea. Then Christmas came in the way, and our start was delayed until the 26th, when we at length got off—a caravan of nineteen persons and fourteen mules. Shortly before our departure from the town, I had the honour to receive a visit from the political authorities, and I did not at first perceive what was the object of the interview; but just before they left, the principal official thus addressed me:—"Señor, we understand perfectly that, in an affair like yours, it is necessary to dissemble a little, and you, doubtless, do perfectly right to say that you intend to ascend Chimborazo, a thing which everybody knows is impossible. We know perfectly well what is your object; you wish to discover treasure which is buried in Chimborazo, and, no doubt, there is much treasure buried there, and we hope you will discover it; but we also hope that when you have discovered it you will not forget us." "Gentlemen," I said, "I should be delighted to remember you, but in respect of the other matter, the treasure, I venture to suggest that you should pay half the expense of the expedition, and take half the treasure we discover." But this idea was rather too speculative for them, and the interview produced no result.

On our way up, we went over the Quito track, and then, leaving the road on our right, we bore away directly towards the mountain. Night set in just as we were fairly arrived at its foot, and we encamped at a height of 14,400 feet, having risen 5,500 feet in coming from Guaranda. During the night two Indians, who had been acting as porters, deserted, and five mules also ran away. Our carrying power being thus reduced, it was necessary to make two journeys from the first camping place on the ridge, to a place very near the summit, S.W. by S., where the Carrels had selected a place for the second camp. Jean Antoine went away with the first detachment, and Louis and myself returned to fetch up the others. The rest of us then went up and arrived at about a quarter to five in the afternoon, having risen about 2,100 feet. We were now more than 16,500 feet high, and established ourselves there with provisions enough for three weeks, and with fuel enough for several days. All water had to be obtained by melting snow, of which there was enough round about us, and to keep up our stock of fuel and communications with the world below, I retained a muleteer and one beast to go backwards and forwards between our camp and the nearest hovel.

All the rest of our troop now left us, and did so very gladly; for although we had succeeded in establishing our camp on the selected spot, it had only been done by the greatest exertions on the part of my people and their beasts. The mules were forced up the very last yard that they could

go, and staggering under their burdens, which were scarcely more than half the weight they were accustomed to carry, stopped repeatedly, and by their tremblings and falling on their knees, and general behaviour, showed that they had been driven to the very verge of exhaustion. When we arrived at the second camp, we ourselves were in good condition, which was to be expected, as we had ridden up the entire distance from Guaranda; but within an hour I found myself lying on my back, along with both the Carrels, placed *hors de combat*, and incapable of making the least exertion. We knew that our enemy was upon us at last, and that we were experiencing our first attack of mountain sickness. We were feverish, had intense headaches, and were unable to satisfy our desire for air, except by breathing with open mouths. This naturally parched the throat, and produced a craving for drink, which we were unable to satisfy, partly from the difficulty of obtaining it, and partly from the difficulty of swallowing it, for when we got enough, we were unable to drink, we could only sip; and not to save our lives could we have taken a quarter of a pint at a draught. Before one-tenth of it was down, we were obliged to stop for breath, and gasp again, until our throats were as dry as ever. Besides having our normal rate of breathing largely accelerated, we found it impossible to get along without every now and then giving a spasmodic gulp, just like fishes when taken out of the water. Of course there was no desire to eat; but we wished to smoke; and even our pipes almost refused to burn, for they, like ourselves, wanted more oxygen. This condition of affairs lasted all night and all the next day, and I then managed to pluck up spirit enough to get out the chlorate of potash, which, by the advice of Dr. Marcet, I had brought in case of need. Chlorate of potash was, I believe, first used in mountain travel by Dr. Henderson, in the Cara range, and it was subsequently ordered by Sir Douglas Forsyth in his mission to Yarkand in 1873-4. The surgeon to the expedition states that he distributed little bottles of it amongst the members of the embassy, and says that, from his own experience, he can testify to its value in mitigating the distressing symptoms produced by a continued deprivation of the natural quantity of oxygen in the atmosphere. Before my departure, Dr. Marcet urged me to experiment, with a view to confirming this experience; ten grains to a wine glass of water was the dose recommended, to be repeated every two or three hours if necessary. I say distinctly that I thought it was of use, though it must be admitted it was not easy to determine, as one might have recovered just as well without taking any at all. Anyhow, after taking it, the intensity of the symptoms diminished; there were fewer gaspings, and in time a feeling of relief. I am so far in favour of its use, that I should always carry it on future expeditions. Louis Carrel also submitted himself to the experiment, and seemed to derive benefit, but Jean Antoine, the elder of the two, sturdily refused to take any doctor's stuff, which he regards as an insult to intelligence. For all human ills, for every complaint, from dysentery to want of air, there was, in his opinion, but one remedy, and that was wine; most efficacious always if taken hot, more *especially if* a little spice and sugar were added to it. His opinions on thin[
were often very original, and I le
whilst in his company; amongst o
that for the cure of headache, no
can be mentioned than keeping the
and the feet cold. I am bound
practised what he preached, and I ca
no more curious sight than that of this
man, lying nearly obscured under a pil
with his head bound up in a wonder
ment of handkerchiefs, vainly attempt
a short pipe, whilst gasping like an
codfish, his naked feet sticking out
neath the blankets, when the tempe
tent was much below the freezing poi

It seems curious to relate that M
not appear to suffer at all, and excep
should have fared somewhat badly.
fire going—no easy task, for the fi
to suffer from want of oxygen just li
and it required such incessant blowin
consider for the future a pair of be
dispensable part of a mountaineer's
Mr. Perrin behaved on Chimborazo in
manner—he melted the snow, broug
and attended to our wants in gene
therefore, somewhat against the grai
he was in very poor health in co
having led rather a dissipated li
he was so far debilitated that h
walk a quarter of a mile on a flat
desiring to sit down, or 100 yards on
side without being obliged to rest.
aware of his previous history, he cert
not have accompanied us. You will
quire—How can you account for
with his shattered constitution, who
mountaineer, being unaffected, when
who were all more or less accusto
ascents, were, for a time, complete
The explanation appears to be this.
been for a long time resident in
heights of from 9,000 to 10,000 fe
several times passed backwards a
over a height of over 14,000 feet.
elevation at which he had resided
last 10 years was, in all probability,
than the mean elevation at which w
lived, and it would probably have bee
he been subjected to examination, tha
of respiration, and even his organs,
better adapted to a pressure of 18½ i
was the height of the mercurial co
second camp.

On December 29th, the Carrels we
better, and were eager to be off ex
sent them away to continue the ascen
on which our camp was placed. I in
not to go to any great height, and to
another and higher camping place.
our ridge was trap—I have a samp
—it was shattered by frost, and e
a state of ruin. Just above our tent
enough to traverse a stony waste, r
patches of sand. Higher up it becam
and, at about 17,000 feet, it was nece
a little. Then its angle diminishe
were large snow drifts on each side
the crest of the ridge was compos
and frozen ice. At 18,500 feet the

an end. It was crossed by some precipitous rocks, and after passing these, you entered on the snow region which crowns the mountain on all sides. On the east of this ridge we had rather a considerable glacier, which was fed, if not entirely formed, by the ice which fell from above, and at its sides there were sheer cliffs, over which the glacier which caps the mountain was projected. The masses of glacier which fell from these cliffs tumbled over the precipices and the slopes at their base 3,000 feet before they were arrested by the glacier beneath, and in the course of falling brought away enormous fragments. The glacier was laden with huge ice blocks and the rocky fragments which it brought down, and we accordingly called it the *Glacier de débris*. These cliffs, and those which face N.W., are the most elevated and the greatest on Chimborazo, and they were quite sheer and inaccessible. They were composed of a number of marked strata, disposed with great regularity, and it was easy to identify the beds from which fragments had fallen on the glacier by the colour alone. All were trap; some were vitreous; some stony, and they presented the widest variety of colours, from a delicate rose to a coarse red, and from pale grey to the black of the beds of lava. The whole of the rocks, and I collected some 30 varieties, are distinctly volcanic, and the doubts which still seem to linger on this matter are now finally disposed of. The very highest rock I obtained, from about 15,500 feet, is an absolute cinder.

The Carrels returned soon after dusk, both extremely exhausted; they could scarcely keep on their legs, and threw themselves down and went to sleep without eating or drinking. Their condition, and the report I heard next day, rendered it certain that our second camp, as a starting place, was not placed high enough. It appeared that the Carrels, neglecting my instructions, had been towards the summit, and reached a height of only about 19,500 feet. They were quite unencumbered, carrying no instruments, and only enough food for their own use, and had no traveller to look after, and yet came back quite exhausted. It was obvious, therefore, we should have to get still higher up before we could make an exploration of the real summit. So soon as they were well enough, I sent Louis down to the camp to fetch up the tent, which had been left there, and as soon as it arrived, we were in a position to go forward again. On the following morning, I went myself up the ridge to look for a higher camping place, and found one on the eastern side on some broken rocks, at a height of 17,400 feet. By this time, I was in rather better condition than the Carrels; the feverishness had disappeared, and my blood had resumed its normal temperature. The gaspings had nearly ceased, and the headache had gone. You will perhaps wonder how I knew I was feverish; for in regard to this matter one is often mistaken, and fever is supposed when it does not exist. By the advice of the distinguished physician whose name has been already mentioned, Dr. Marcet, I had provided myself with a registering clinical thermometer, for the purpose of taking the blood temperature at great elevations. This was duly done, and, in respect of this matter, nothing more need be said than that at our greatest heights the temperature of the blood was just as it is at the level of the sea—higher during periods of warmth, and lower when unusually cold. But still, at its normal height, when the thermometer is at 60° or thereabouts, it did not appear to be affected by a low atmospheric pressure at all. In recommending me to take this little instrument, of which I have one in my hand, Dr. Marcet rendered me a great service, and amongst all the devices and instruments which have been pressed upon the attention of travellers in general, of late years, I know nothing equal to it in importance. By constant observation, I was able to detect the earliest advances of fever, and by taking proper steps in time, was able to get through the entire journey without having an attack of fever worth mentioning. Its expense is trifling, and it can easily be carried in the waistcoat pocket. When we were first laid on our backs by mountain sickness, it showed that my blood temperature amounted to 100·4°, but by the end of the year it had fallen to its usual height, viz., 98°. Still, although the more disagreeable symptoms had gone, we found ourselves remaining comparatively lifeless and feeble, with a strong disposition to sit down when we ought to have been moving. There was plenty just about this time to keep us moving. First the muleteer, who was retained to keep up communication, came up and reported that some boxes left in depôt at the first camp had been broken open and robbed. This involved going down to make an inspection, and dispatching Perrin to Guaranda. Then we found a quantity of tinned-meat had gone bad, and we had a world of trouble over it. I had invested in a quantity of ox-cheek, and one tin had been placed in each of our cases. Upon opening the first case, I noticed that the end of the ox-cheek tin had bulged, and, knowing what that meant, I had it thrown away at once. One after another we found the same thing, and at once, on opening another, a most vile stench rushed out, and I found the ox-cheek had burst its bonds, and not only became putrid itself, but had corroded and ruined almost the whole of the food in the case. It then became necessary to examine seriatim each case, to know exactly how we were off for food, and the end of the matter was, we found ourselves obliged to hurl over the cliffs, provisions that had cost us, in round numbers, £100.

It would be merely wasting your time to recount the troubles we had in the wind, hail, snow, and thunderstorms—which we had night and day—from which we suffered each and all. The snow fell occasionally as much as six inches at a time; it was always fine and granular, and not in flakes. But we had far more hail than snow, and it fell continuously. Thunderstorms visited us with unvarying regularity every day. These occurrences delayed our progress, and it took three days to move the requisite quantity of material up to the third camp. At length, on the 2nd January, last year, having passed the night at our highest station, leaving communication open in our rear, I conceived the time had arrived when we might prudently make for the summit, and on the following morning, at half-past five, the Carrels and I started, and mounted about 1,000 feet without any great difficulty. We had arrived at the rocks I have spoken of as crossing the ridge of the mountain. We were half way up this when a furious and intensely cold wind arose, and we found our-

selves compelled to abandon all the things we were carrying, and to fly for refuge to the camp, holding ourselves in readiness to start the next morning. This happened to be very fine and cloudless, and profiting by the steps we had made the previous day, we mounted by a fair road, crossing these rocks and getting to a height of about 18,400 feet at eight o'clock. We then bore away to the left, that is to say, towards the west, over a snow-covered glacier, and ascended spirally, so as to break the ascent. There were few crevasses; the snow was in good order, although steps had to be cut in it. I noticed that our steps got shorter and shorter, until at last the toe of one foot touched the heel of the previous one. At 10 a.m., at a height of 19,500 feet, we passed the highest rock, which, I have already said, was nothing but a volcanic cinder. For some distance further we continued our progress at a reasonable rate, having fine weather and a good deal of sunshine. At about 11 a.m., we fancied we saw through the heavy clouds which covered the whole country to the west, and shortly afterwards, being then nearly 20,000 feet high, we arrived at another plateau near the top of the mountain. The summits now seemed within our grasp; we could see both, one on our right, and another a little further away on our left, with a hollow plateau about one-third of a mile across between them. We remarked that in about another hour we could get to the top of either, and not knowing which of the two was the higher, we made for the nearer, but at this point the condition of affairs completely changed, the sky became clouded all over, wind arose, and we entered a large tract of dusty, soft snow, which could not be traversed in the ordinary way. The leading man was up to his neck, almost out of sight, and had to be pulled out by those behind. Imagining we had got into a labyrinth of crevasses, we turned about right and left to try and extricate ourselves; and after discovering it was everywhere alike, we found the only possible way to proceed was to flog every yard of it down, and then crawl over it on all fours, and even then, one or another was frequently submerged, and almost disappeared. Needless to say, the time went rapidly. When we had been at this sort of work three hours, without having accomplished half the remaining distance. I halted the men, pointed out the gravity of the situation, and asked them whether they preferred to turn or go on. After consulting together, Jean Antoine said, "When you tell us to turn we will go back; until then we will go on." I said, "Go on," although by no means feeling sure it would not have been best to say "Go back." In another hour and a half, we got to the foot of the southern summit, and as the angle steepened, the snow became firmer again. We arrived at the top of it about a quarter to four in the afternoon, and then had the mortification of finding it was the lower of the two. There was no help for it, we had to descend to the plateau, resume flogging the road, and floundering on, to make for the highest point. There again, when we got up to the dome, the snow was reasonably firm, and we arrived upon it at last, standing upright like men, instead of grovelling, as we had been during the last five hours, like beasts of the field. The wind was blowing at the rate of about 50 miles an hour from the north-east. We were getting wretched and hungry, without having the means to satisfy ourselves. \ trouble, a mercurial barometer was : man grasped the tripod, another to give it shelter by a poncho wind, and I, myself, lay on my the snow watching the descent of tl It fell until it was 14·1, at a 1 of 14° Fahr., which, when compare observation made on the same day at gives for the height of Chimborazo By the time the barometer was in its it was 20 minutes past 5 o'clock, and scarcely an hour and a quarter of dayli ing. We fled across the plateau at possible rate. There is, as you are aw difference between descending and asc snow, and as we had a huge trough already made, we moved down it parative facility. Still, it took near to extricate ourselves from that p then ran, for our lives, for our arr camp that night depended on our be cross those rocks before darkness fa We just succeeded in arriving at th although it became pitch dark before them; then we saw our camp fire, and disconsolate shouts of Perrin, who was as we came hurrying down, and we a soon after 9 p.m., having been out nea on foot the whole time.

The hurried way in which we left t made me desirous of ascending again, l that Louis Carrel was *hors de combat*, his foot frost-bitten. As soon as it co he was sent down to the nearest he could receive attention, and myself up two days longer at camp. On the 12th of January I rej and we then moved by easy stages d Machachi. We waited there for nearly before he could take the field again. Th suffered very severely, but it is due to yo it was through his own fault. On leaving the ascent, I remarked he was not wea but he said he was accustomed to Jean Antoine used gaiters of the usual used a pair which, from having the l tinued all round, are well nigh im water. In wading through the sn summit it was wet as well as soft, Carrel got his feet badly wetted, wards they froze, whereas Jean Ant returned to the camp quite untouched.

My residence on Chimborazo thus ex 17 days; one night was passed at 13,400 feet, ten at a height of 16,500 17,300 feet. During this time, besides to the summit, I also went three time 18,300. When we quitted the mounta of mountain sickness had disappeared touch us again until we arrived at the Cotopaxi.

This is a convenient point, before to Cotopaxi, to say a few words res country and the people of the co manners and customs. The road to Q already said, goes over the southe Chimborazo. It then passes around side of Chimborazo, and then g down to Arenal, and so to Quito.

se, called Chuguipoquio, is for the most ly a rough mountain track, but here again se to a made road, which continues without sion to Quito. This is the only made the whole interior, and it is a busy one, enty of life passing along it. In December, I reckon we met or passed not less than easts, and 500 persons every day. A newly- . European is somewhat astonished, that his large traffic, the track should be left in villainous condition, but after having been he other so-called roads in the interior, his n disappears, and he begins to regard the track as something very superior indeed. I bound to say I did not on any part of it ad more than two feet deep, whereas er roads we had mud three and four eep. Even this is considered a very mount, and an old resident in Ecuador ebuked me for calling a road bad in ur beasts had sunk half way up their flanks. ig him what he called a bad road, he said: oad is bad in which the beasts tumble d holes and vanish quite out of sight." Quito road you meet with a great of character. A large portion of the n, probably one half, is composed of pure who were found by the first Spanish con- The remainder of the population consists of a mixed race. It is universally ad- it their are very many Indians of perfectly cent, whose families have never been y alliance with whites, but it does not be possible to find a single Spanish or opean family which has not contracted with the Indians. We had many deal- the Indians, and found them on the be honest, truthful, and well-disposed. certainly, for the most part, hardy, is, and tolerably intelligent. They are r. We saw extremely little drunken- ongst them, except in the Province north of Quito, where they are very and prosperous. The small number of d persons seen throughout Ecuador is le, and I was inclined to regard the a very sober race, until I learned that it abit of the country when any one wished ik, to go to bed and get quietly drunk in bed. very interesting custom, and it might be eous to introduce it amongst ourselves, nkenness is abolished altogether. The rt of the persons mentioned on the road, lly those concerned in the traffic between l and Quito and other towns in the in- avelling for the sake of seeing the country re unknown; but occasionally you meet one a little out of the common, who is to pay a visit to some neighbouring d such a person is generally worthy of . If he is got up correctly, he will be his so-called Panama hat, a straw hat l roll up, and costs any sum from about £10. To take care of this precious puts on a white outer casing, and as l get spoilt by the rain, he puts an oil- on the top of that, so that he has three one over the other. To protect his ught to be wearing a pair of blue goggles, sold in Birmingham at half-a-crown a dozen, and, in Quito, at half-a-crown a-piece. Outside he will probably have on a poncho of superior quality such as this, and underneath it a coarser one. What he may wear in the guise of trousers I cannot say, because they are covered with buskins made of the skin of some wild animal. His feet are very nearly invisible, and if you see them, you will most likely notice his toes peeping through his shoes, but, for the deficiency thereabouts, he makes up in the heel by his spurs. Here is a specimen of these articles, but this is considered a moderate thing in spurs; I can assure you many are worn more than double the size, Altogether he is what we should call a regular guy. But we have not yet done with him. If he is properly turned out, he carries at his button-hole a drinking cup, which may be carved and silver mounted; at his side a tremendous chopping knife, which is used either for cutting away branches or as a tooth-pick. If he is a person of great distinction, he will be strong in his whip, which will have a wrought-iron handle, as it is found that one of that description does not break so readily on the heads of mules as wooden ones. He will also carry a guitar at his saddle. Such a person, according to the phrase of the country, is a great cavalier, and if only decently mounted, he may aspire to marry any woman in the land. It is needless to say that, in roads in the state I have described, there are many accidents to baggage animals; beasts get stuck, their loads are thrown off, and sometimes abandoned, but what causes, I believe, far more loss, is the pilfering which takes place, and which it is almost impossible to prevent. I have been offered bottles of brandy by persons on the road, who, I am quite certain, could not have come honestly by them, and I have seen wine cases taken off a mule, taken indoors, opened, a bottle or so taken out, the case fastened up again, and loaded. To illustrate this I may tell you a case which was related to me on a visit to a fraternity of Jesuits. One of them said to me, "Señor, you know that the wine of this country is both dear and bad, and we thought that if we imported it ourselves, direct from France, we might get a pure wine at a moderate price; and so we ordered, as an experiment, a cask from a French house, but it cost us very dear. When it arrived, we were glad to find that it was full, and that it did not leak; but I am sorry—oh, I am sorry to tell you, that when we opened it, we found that it was full of very dirty water." These accidents, and the weight of the heavy duties which are imposed are, no doubt, the main cause of the high price of foreign goods at Quito, and in the interior generally. An ordinary quart bottle of "Bass" costs 4s., and a pound of English salt, 3s. 4d., while a common iron bedstead, that would be dear in London at 50s., I have seen marked at £9. Accidents notwithstanding, these prices appear to leave a good margin for profit, and an enterprising man could probably make 100 per cent. on his transactions. You must remember, however, to take into account an unknown quantity of earthquakes and revolutions. You may be a rich man one day, and a bankrupt the next. Trade in these regions may be said to possess all the excitement of gambling without its immorality; but it does not appear to be very fascinating to the English, for,

at the time of my visit, I found only two of my countrymen in Quito. In touching on morals, I tread on delicate ground, because what the Ecuadorians consider moral, we should term immoral. I shall, however, relate one instance, which conveys a vivid idea of the manners and customs of the country. Some years ago, the late Archbishop of Quito, who was a much respected man, moved to indignation by the immorality of some of his flock, tendered a reproof; but some sons of Belial, in revenge, stole into the vestry on the occasion of an important church festival, and put strychnine into the sacramental wine. The Archbishop partook of it, and fell dead before his people. This incident created so great a sensation, that the authorities forgot to punish the assassins, who are still at large, and—perhaps, to prevent a repetition of such things in future—they suppressed the Archbishopric, and seized a great part of the revenue. You have here developed in this single instance a gross, immoral, and atrocious crime which is left unpunished, and a flagrant disregard of vested rights. As this is the description of the people themselves throughout Ecuador, you will see good reason for the non-interference of a strangers in their politics. I studiously avoided meddling with their concerns; still it was not possible to be any length of time in the country without hearing a good deal about its domestic affairs, and in some respects these are both interesting and edifying. The Parliament, or House of Assembly, it is said, comes together only on rare occasions, and when it meets it manages to do without all-night sittings, and its members obey the ruling of their President, and vote exactly as they are wanted. It might be worth while for her Majesty's Government for the time being to send a special commissioner to Ecuador, to learn how this desirable state of affairs can be arrived at. Then with respect to finances, they manage extremely well. There is no augmentation of the public debt, for the simple reason that no foreign country will lend them money, and the inhabitants are far too wise to lend it to each other. This universal distrust arises from the undeviating habit of repudiating contracts. No bargain ever seems terminated, and in respect of this matter, one of the most respectable and honourable of foreigners in Quito told me that he never considered a transaction completed until he had given his customer a whipping. The marks of the whip, it seems, answer the place of a receipt stamp. The Ecuadorians are, as I have said, a very interesting people, and there is much that is curious and amusing in their manners and customs, but it is most pleasant to study these at a distance.

In passing from Chimborazo to Cotopaxi, we go from an extinct volcano to an active one, and to one of the most terrible volcanoes in the world. It is situated, roughly, north-east from Chimborazo, at a distance of 65 miles. From Quito, it bears south-east about 33 miles. Three years ago, during the last great eruption, ashes from it fell in Quito to such an extent, that it was pitch dark at mid-day, and persons in the streets in front of their houses could not tell where they where. On this occasion, too, there was a great manifestation of flames, which rose to an enormous height; the larva rapidly liquified, and poured down in torrents, which caused rivers six miles dista[illegible] rise 60 feet above their ordinary height, and i[illegible] instance, I was informed, it carried away a b[illegible] 100 feet above the stream in the village of Ant[illegible] where a cotton factory was established 25 miles from the mountain; the whole was razed, and the heavy machinery wa[illegible] ried 30 miles down the river. All rou[illegible] mountain the natives have stories of th[illegible] mendous ravages which occasionally occu[illegible] general opinion seems to be, that the pe[illegible] greatest activity are always preceded by [illegible] of repose. In fact, it is said of the moun[illegible] it is of children, when it is quiet it is su[illegible] in mischief. During my enforced stay, [illegible] illness last March, I was in the im[illegible] neighbourhood of this mountain, and abundant opportunities of studying its haviour. It was unusually tranquil, and though fretting and fuming, and giving occas[illegible] growls, conducted itself on the whole in a g[illegible] well-behaved manner. I several times re[illegible] that during the night much less smoke or [illegible] came away from the crater than during the d[illegible] this led me to conclude that if we could pass a[illegible] on the summit, we should be able to see t[illegible] bottom of the crater, a sight no one had hith[illegible] enjoyed. So far as one could judge by exam[illegible] tion with the telescope, it did not appear tha[illegible] should be able to find a reasonably protected p[illegible] on the all but naked final cone; so, in addition t[illegible] troubles which were likely to occur from livi[illegible] a great altitude, we had the chance of b[illegible] blown up by the mountain, or being blown [illegible] by the wind.

All our arrangements were carefully ma[illegible] and we started for Pichincha, passing at [illegible] through a small hamlet, then turning [illegible] and then up a ridge of the mountain, [illegible] descends towards the west, and encamped [illegible] height of about 15,000 ft. As the transpo[illegible] our camp equipage, all through, was beyond [illegible] power of the Carrels, I called for volunteers [illegible] amongst the natives, and those who came we[illegible] proceeded to dress up in accordance with our views of propriety. The native dress is a[illegible] suited to mountaineering as it can well be; [illegible] mencing with a straw hat, which always b[illegible] away; then a long poncho, a variety of bla[illegible] with a slit in the middle, through which the [illegible] is passed, and this is sure to fly up in your fac[illegible] critical moment; then rough shoes, which, alth[illegible] not unsuited to ordinary use, are totally inade[illegible] to snow or rock-work. The rest of their at[illegible] of the most flimsy description. I am spe[illegible] now, of course, of the inhabitants of the int[illegible] living at a height of 8,000 or 10,000 feet, at [illegible] there is an almost invariable temperature of [illegible] 60 degrees. In the lower country much less is worn, and they seem to have attained, in [illegible] cases, the perfection of simplicity. I hold i[illegible] hand the entire dress of a native of St. Miguel Colorado. This is a fit dress either for a g[illegible] party or an evening assembly, and as [illegible] appears to be some connection between uns[illegible] ness of attire and perfect bliss, you may [illegible] yourself when there, if not in Paradise, at [illegible] not far from the Garden of Eden.

On the 16th we sent up the first instalme[illegible]

res to the final cone. The weather was very rith a varying temperature, and I did not till the 18th. The view from our camp led over a large expanse of country, by cracks and fissures, in every direcovered with cinders and blocks of larva. sed curious that although the cone, for at six or seven miles in all directions, was d with lumps of scoriæ, which, from the r in which it was dotted about, appeared to ded from the crater, I could not learn that ption of any considerable volume had ever witnessed on the part of the natives. Some led the idea that they had ever been thrown yet in respect of fire, water, and ashes, everyd something to say. They generally agreed ing that flames were frequently seen to rise the rim of the crater, and that even when va is not flowing, and ashes are not being l.

he morning of the 18th, we started before k, and at half-past six arrived at the edge rater. We had so far improved in conhat when between 18,000 and 19,000 feet, 360 steps without stopping, and only hen because our men were tired. The not be said to present any difficulties; almost the whole way over snow up to one, and then over ash mixed with ice. cone is the steepest part of the ascent, ir side presented an almost continuous 5 degrees.

anced, and from a few feet of the edge ad to peer into the unknown. A vast of smoke and vapour was boiling up, nly saw at intervals a portion of the de, the bottom being invisible. We then o make a place for the tent, with the of the natives. When this was done, we back to the first camp, and the Carrels ined alone. The camp was necessarily on the outside of the final cone, which, at was entirely composed of ash. This was to the touch, and so loose as to render it a much trouble to fix the tent ropes, wind springing up, we carried out ional ropes, and attached them to the nes we could find, and bury in the ashes. gged up a rope, as a sort of hand-rail, nt immediately to the edge of the crater, it was distant about 250 ft. We had mpleted the operation, when a violent e, which threatened to carry our whole ent away. The poles of the tent quivered, ragged, and it was a question whether ould weather the squall. But the storm ay as suddenly as it arose, and for the stay we were not much troubled by the ile this was going on, we had another alarm. A great smell of india-rubber l to arise; and putting my hand or of the tent, I found it was on of melting; and placing a maximum er on the floor it rose to 110°. As my t feel at all warm, I tried in another found on the other side of the tent it d in the middle 72°, whilst outside it ly cold, and in the night a minimum of wn in the temperature.

als of about half-an-hour the crater regularly blew off steam; no stones were observed. The steam appeared to be very pure; it rose in a jet of great violence from the bottom of the crater, and boiled over the edge, continually enveloping us. The noise made on these occasions resembled that which we hear when a large steamer is blowing off steam. We sustained scarcely any inconvenience from it, and this was the more remarkable since we had been well nigh stifled with sulphurous vapour about 1,500 feet from the edge of the crater when coming up. When night had fairly set in, we went up to view the interior, and saw the whole of its vast proportion for the first time. By measurements made on the following morning I find that the rim has a diameter from north to south of 200 feet, and from east to west about of 1,500. The rim is irregular, some points being considerably higher than others. The rock is trap; in the interior the walls descend to the bottom in a series of steps, and a precipitous slope of about a thousand feet. At the bottom there was a nearly circular spot of glowing fire, 24 feet in diameter. In looking at this, it was impossible to say whether liquid lava filled the pipe up to its orifice or not. Flames were flickering and travelling about in all directions, so that what was underneath them appeared more like incandescent than molten matter. The heat at the bottom of the crater was evidently intense, and far up its sides, in every direction, glowing fissures, from which flickering flames were also coming, showed that lava was red-hot below the surface, while columns of steam or smoke rising from hidden orifices, heightened the effect. It is impossible to conceive a more dramatic spectacle than this vast theatre represented, illuminated below by the subterranean fires, and above by a brilliant moon, whilst every now and then these outbursts of steam occurred, rushing upwards with the force of a hurricane, and scattering all around fragments of fused rock. Then—although I had said the steam appeared to be pure—we found in the morning the tent was black with ash which had been ejected. Had we remained on the summit only a short time this would not have been noticed. The fragments were found, on microscopical examination, to be particles of fused rock, and they are, I think, torn off by the violence of the steam blasts. This will be found to be of interest in connection with what you will hear subsequently. I attribute these outbursts to the infiltration of the snow and hail which falls on the final cone. It is almost immediately liquified, and descends into the bowels of the mountain. We noticed while on the mountain, that the whole upper part of the cave was white with snow or hail, and yet in the course of an hour or two it would entirely disappear and descend into the mountain. On one occasion, while on the summit, it hailed so violently as to cover us with an inch of ice, and yet in half-an-hour this entirely disappeared.

The height of Cotopaxi is 19,600 ft. Our camp was placed about 130 ft. below the loftiest point, and was the most elevated position at which any of us had ever lived. We remained there 26 consecutive hours, feeling slightly at first the effects of the low pressure, having the same symptoms as we noticed on Chimborazo; and we used chlorate

of potash, and remarked its good effects. All the signs of mountain sickness had passed away before we commenced the descent, and they did not recur again during the journey. Nearly five months later, we found ourselves again on Chimborazo. I desired to make a second ascent for several reasons, but principally because our stay on the summit, on the first occasion, was too brief to permit us to accomplish our work. Besides, the observations of the barometer were somewhat hurried, and I did not feel sure that the deduced heat established a good determination. If, however, a second reading should accord with the first, it would, besides confirming it, establish confidence in respect of observations made in the meanwhile on other mountains. We were too much laden on the first occasion, but now we had trained two natives into respectable mountaineers in order that they might support us. After ascending a peak, we crossed a depression between two mountains, and encamped in a charming spot, surrounded by butterflies and humming-birds. Next day we mounted up to camp five, which was almost 15,000 feet above the others. My time had nearly expired, and we were delighted by a stroke of great good fortune. Next morning was clear and even cloudless, and we saw long before dawn our old friend Cotopaxi in the far distance, and remarked how tranquil it looked—not a sign of smoke was rising from the great volcano. We went on foot, and before daylight, soon commenced to ascend the ridge which leads continuously towards the second summit. I was in the rear, stopping to heat my numbed hands, and looking towards Cotopaxi, when all at once I saw a column of smoke commence to rise from the crater. It went up straight into the air, rapidly curling with such velocity that within a minute it had risen 20,000 feet above the crater. It was caught by an easterly wind, and borne 20 miles towards the east, at right angles, towards its former course; it then turned, and a northerly wind carried it towards our position. As the cloud came nearer and nearer to us, it appeared to rise higher and higher in the sky, and about twelve, at noon, it got overhead, and shut out the sun. But before this happened, we witnessed the most extraordinary and startling effects in the atmosphere between us and the volcano—a thick cloud, sometimes like shining brass, then turned to tarnished copper, or the most extraordinary green, producing a feeling of intense astonishment, which could not be banished. In the curled openings in the clouds that arose after the commencement of the eruption, I still saw a majestic column of ash pouring out, and rising to an immense height in the air, blacker than the deepest ink. As we were engaged in the ascent of Chimborazo, and had many other things to occupy our attention, we did not appreciate at first the magnitude of the eruption, but when we got on the summit, and found the ash beginning to fall to such an extent that the snow looked like a ploughed field, we perceived something out of the common was happening. We arrived on the summit at 20 minutes past 1 on this occasion, and had the satisfaction of finding the end of a flag staff, which had been put up on the first occasion, still appearing above the *snow*. You will readily believe that I referred to the barometer with no little eagerness, and read 14·28 in an air temperature of which gave for the height of C 20,489 feet, or 56 feet less than on occasion, the mean of the two deduct 20,517.

When we returned to our tent on October, we found it laden with ash from It was still falling, and covered the round as with a dense fog. I collected three ounces from the tent, but this w that which was upon it, and much m off down the sloping sides. I su found, in the town of Ambato, nearer the mountain, between 11 o 11.15, upon a piece of paper spread it, one foot square, four ounces were col from these data I have made a calcu the minimum quantity which must ejected, drawing two lines from Cot leading to Riobamba, 20 miles to the station, and another on a line as far t within which limits I am certain this ash at least two million tons of this ash been ejected during this eruption. T is under-estimated in a variety of way was carried beyond the limits indic believe it fell over many hundred s further. The quantity taken into a that actually found on the tent, but fr northwards, that quantity only is r fall in a quarter of an hour. Profes has recently submitted this to m examination and, estimating the s particles, we find the ash which f tent at the summit of Cotopaxi was so fine that 4,000 particles scarcely wei That which fell upon it when on Chin much finer, and in estimating that 25, go to a grain we are well within the n bear a strong family resemblance to and consist principally of glassy fels long crystalline scoreous dust. It is that which fell on us on the summit wa the steam blasts to which allusion has and I conclude that the matter which during the other eruption was torn off out by a continuous blast of almost i violence.

If you can picture to yourselves the is required to eject two millions of to (so light that 25,000 particles scar grain) to a height of four miles in the from the crater, and to send it up v affected by the east wind, you may form some idea what a terrible creat is in his more furious moments.

This, ladies and gentlemen, brings to a close, and, in conclusion, permit word more in respect to mountain e general. Amongst certain persons it is able to affect a description of scorn, l contempt, for anything in connection wi and mountain work. None of us feel, p deeply the criticism of those who are ignorant of the subjects on which t for this matter speaking for myself, I forward to the time, which will surel the study of mountains, the ascent o and even prolonged residence on mo

...und essential for the prosecution of a score of ...ces. Before this could be carried out, it was ...sary to learn whether life could be made en... ...ble at great heights. We were always haunted ...e fear of an invisible enemy who might strike us ...at any moment. What we wanted to know was, whether life could exist at a height of 20,000 ...; that was settled 75 years ago, by Goy Lussac; whether man could become so far habituated to ...low pressure which is experienced at that ..., as to be able to live without inconvenience, ... useful work. I went to the Andes in ... the answer to this question, and having ... story, you can form an opinion whether ... an encouragement for the prosecution of ... in other quarters. There is, I think. ...partment of travel more fascinating than ...ineering. Mountains present the grandest ... features, they will be always equally ... near or far, in cloud or in sunshine; ...wonderful variety of outline, their startling ... of colour, and their dazzling effects, have ... sources of inspiration for poets and for ... They afford perpetual instruction to ...ogists, and they will, no doubt, one day ...light on those great questions touching ...n and distribution of species which have ... exercised the ingenuity of botanists ...ogists during recent years. Mountains ...nate, give birth to rivers, have fixed the ...s to kingdoms, and have determined the ... races; they have often wrecked the ...of the invader, or sustained the hopes of ...ot; they form some of the best material ...s for the peace of the world. So far ...ng inclined to take a low view of the ... of mountaineering, I hold that the ...d the exploration of mountains is of the ...ortance for the purposes of political and ...geology.

...irman then proposed a cordial vote of ... Mr. Whymper, which was carried ...ly.

MISCELLANEOUS.

...TION OF CAOUTCHOUC TREES IN INDIA.

Markham's recently published "Peruvian ...ere is an appendix on the above subject, and ...and other sources the following account has ...n up by Mr. James Collins.

...ary, 1868, a paper appeared in Dr. Seemann's ... of Botany," on "The Commercial Kinds ...ubber or Caoutchouc." by Mr. Collins. This ..., for the most part, a *résumé* of what had ...en on the subject, and also contained the re... ...rsonal observations on the preparation and ... of that article, together with an endeavour to ...anical sources of the various varieties.

...istance of Mr. P. Le Neve Foster, and the ...ed botanist and traveller, Dr. Seemann, the ...this article followed up the subject, and the ...is further researches were given in a paper, ...India-rubber: Its History, Commerce, and Supply," read before the Society in December, 1869. The concluding remarks in this paper are as follows:—

"There is one subject which I would more especially recommend to the attention, not only of those present, but also submit to the attention of her Majesty's Government, that is, the acclimatisation of the different species of *Hevea* (and also incidentally, I would mention the species of *Isonandra*, which yield gutta-percha) in such of our own eastern possessions, as will be found best suited."

Owing to the prominence thus given, the subject of the introduction into, and cultivation of, caoutchouc trees in India was not allowed to drop, and through the representations of Mr. Markham, Mr. Collins was commissioned to prepare a report on the subject for the Secretary of State for India. This "Report on Caoutchouc" was published in 1872. The following passage from it may be quoted here:—

"The cultivation of economic plants, and the acclimation in localities where the various conditions, which are so many elements of success, are more controllable than in their native habitat, has a very important bearing on the commerce of a country, and becomes the more necessary for the sustentation and improvement of trade and manufactures, as the march of civilisation and colonisation or the recklessness of native collectors reduce the area and number of spontaneous forest products. It may be taken as an axiom beyond all controversion, that we cannot long rely on the spontaneous products of the forests, but that recourse must be had, sooner or later, to conservation, cultivation, and acclimatisation in order to keep up supplies of all necessary vegetable products."

The recommendations were that the (1) *Heveas*, yielding Para caoutchouc; (2) the *Castilloas*, Central American caoutchouc; (3) the *Vaheas*, Madagascar caoutchouc; (4) the *Landolphias*, African caoutchouc; and (5) the *Urceola elastica*, Borneo caoutchouc, should be introduced into India; and that the cultivation of the indigenous *Ficus elastica* should be forthwith attended to. Of the various plants mentioned, the relative values of their products were taken into consideration, the *Heveas* and *Castilloas* being specially mentioned.

These views were adopted, and steps taken to carry them into effect. Meanwhile, Mr. Collins sent out full instructions to a correspondent on the Amazons, and was fortunate enough to obtain seeds of the *Hevea Brasiliensis*, and plants raised from these seeds at Kew, were taken by Dr. King to India, in 1873. Thus India obtained her first Para caoutchouc plants. A still larger supply was collected and brought home by Mr. Wickham, in 1876.

Still, not only were seeds and plants to be obtained, but, as was pointed out, there were many questions to be cleared up. Further information was wanted on the physical and climatic conditions under which the trees best flourished, and the best methods of preparing the caoutchouc, &c., and for this purpose observations on the spot were absolutely necessary. In the selection of a proper person, Mr. Markham was so fortunate as to secure the services of Mr. Robert Cross, whose previous travels in search of Cinchona plants, and his knowledge of the country and languages, eminently fitted him for the task.

Mr. Cross left England for Panama Isthmus, in May, 1875, and first searched for Castilloa plants, yielding the well-known Central American caoutchouc. The species which he first met with proved to be the *Castilloa Markhamiana*, so named by Mr. Collins in honour of Mr. Markham. This species grows to a height of 160 to 180 feet, with a diameter of about five feet, and a full grown tree yields about 100 lbs. of caoutchouc. The wood is soft and spongy, and rapidly decays. Some caoutchouc prepared from these trees by Mr. Cross was reported to be superior in quality to that yielded by the historic *Castilloa elastica*. The range, too, of these trees

was so wide that in certain districts part of the year is dry. Of the plants collected, 134 flourished at Kew, and of these a goodly supply was forwarded to India in 1876.

Mr. Cross again left England in 1876, this time to procure seeds and plants of the Cearà caoutchouc tree, and further supplies of the Heveas. In both efforts he was successful, resulting in the establishment of 1,000 plants of *Hevea Braziliensis*, and a goodly number of Cearà plants, all in fine condition at Kew.

The tree yielding Cearà caoutchouc, till this time, was unknown, and to Mr. Cross is due the honour of clearing up its origin. In trying to get up young plants he could not move them, till digging round the roots he found them furnished with tubers of the size and shape of kidney potatoes, and from materials brought home, the plant is recognised as the *Manihot Glaziovii*, a near relative of the tapioca plant. Quotations from Mr. Cross's report on this journey have already been published in this *Journal* (July 12th, 1878), and the report is full of practical information of the utmost cultural value.

Mr. Markham sent the bulk of these plants to Ceylon, from whence, as he says, they can be distributed to suitable spots in India as soon as the Government are less lukewarm on the subject, and fully recognise the importance of the scheme. In Ceylon, the Heveas grow remarkably well, and some trees have reached a height of nearly 30 feet, with a girth of 14 inches. The Castilloas also do equally as well. Later information from Ceylon shows that private planters are taking up the question, and Dr. Trimen, the newly-appointed director of the Peradeniya Gardens has published for their use a series of instructive notes on the cultivation, based on the reports of Messrs. Collins and Cross.

As to Madagascar caoutchouc plants very little information is to hand. Mr. Markham mentions (*Journal of the Society of Arts*, April, 1876) that seeds of *Vaheæ* have been sent to India.

With regard to African varieties, Dr. Kirk has displayed much interest, and has procured many plants of the Landolphias. Mr. T. Christy has procured several plants of *Landolphia florida* and *Urostigma Vogelii*, as well as plants of an apparently new kind from East Africa, yielding an excellent quality of caoutchouc, and some fine and healthy examples of these are now in that gentleman's nursery.

Thus of the various introduced kinds it is pointed out that the Heveas produced the choicest and best caoutchouc, and are well fitted for the moist zones of India. Castilloas will grow over the largest area, and new homes can be found for them in the Western Ghâts. Ceará kind thrives on drier ground, and may find a fitting home in the hot dry plains of India.

In the efforts to introduce these exotics into India, the primary recommendation to cultivate and conserve the indigenous *Ficus elastica*, yielding Assam caoutchouc, has not been lost sight of. The first attempts, commenced in 1873, were comparative failures; but since that date the superintendence has been placed under Mr. Gustav Mann, and under his able management the experiment begins now to assume some importance, and, roughly speaking, there are now 1,000 acres in Assam under this cultivation, and the trees are making vigorous and excellent progress.

One other plant deserves notice—a Burmese one—as likely to prove of great utility as a source of caoutchouc. It is the *Chavannesia esculenta*. This plant, of a climbing habit, was always looked upon as a pest by the forest department of British Burma, and every means taken for its extirpation, as it injured the teak trees. Mr. Strettell, one of the officers, however, discovered that it contained caoutchouc, and seems to have proved conclusively that it will repay cultivation. If this turns out to be the case, it will only be another exemplification of the fact, that "a weed is an unutilised plant."

Thus, although but yet in its infancy, the subj acclimatisation and conservation of caoutchouc trees has arrived at such a stage that its prac is placed beyond all doubt, and the Society congratulate themselves that the warm support to the idea when first brought before them, h an important factor in the present state of affa must the action of Kew be forgotten. The aid and support given to Mr. Collins by Si Hooker, and the great care he has bestowed and plants sent to that establishment, have be utmost practical moment.

As Mr. Markham says:—"This, if intellig continuously followed up, will thus ensur future, as the demand increases, a regular a supply of the best kinds of caoutchouc fro India."

FRUIT GROWING IN THE UNITED S

Consul Cridland, in a recent report, states Florida has very great natural advantages growing, and especially for the orange an fruits peculiar to warm climates. Large distri countries situated between the latitudes of 29° 40′ north, and longitudes 80° 30′ and 82° seem to be particularly adapted to the orange tree, and little else is profitably grown on Formerly, in Florida, as in most of the cott the whole time and attention of the people was in the cultivation of the cotton plant and the Fruit growing was looked upon rather with and no value was attached to the wild orange the State, any more than to the same quantit timbered lands. In fact, very frequently the w trees were cut down and destroyed to mak cotton and sugar. Of late years, however, have found out the importance and profits fruit culture, and the old wild orange trees prized, and are converted into sweet oranges ing. The difficulty in regard to orange cult impatience for immediate results. The c cultivated from the seed, requires from sev years of attention before it begins to bear, an of patience and confidence deters people fro an orange grove, and persisting in its care. E has proved that there is no fear of frost Pilatka. The quality of the Florida orange excellent condition in which it reaches the markets, renders it a most profitable crop. be no fear of an over-production of the lemon when it is considered what a vast co to be supplied. In 1879, 4,000,000 dollars' oranges and lemons were imported into tl States, and the orange crop of Florida w at over 1,000,000 dollars. From informat published in the United States, it is that the orange crop in Florida next seas 100,000,000 of oranges, for which the de give the growers 1,500,000 dollars. Th crop will double itself every three or four y considering that the reports to the Gover that there are over 20,000,000 of trees in groves of Florida, in future years the cro enormous, and exceedingly profitable, and if cent. *ad valorem* duty continues, it will stop the in of oranges from Sicily, Spain, and the W Persons who engage in the cultivation of grove in those parts of Florida where frost unknown, proceed there and purchase from acres of land. Suitable land for orange cul from 15 to 20 dollars per acre. The land is th in, which can be done for 6 dollars per acre. the trees and grubbing the roots, if done th will cost 20 dollars per acre. This work t

o accomplish. Persons are found who under- only to clear, grub, and plough the land, but use the orange trees and set them out. Most purchase and replant trees three years old. to 80 trees are planted per acre; to plant and 300 trees would cost 200 dollars. In two after being set out, which is generally done in or June, the trees are fertilised with guano; and ploughed heavily once a year, and lightly a year. A crop of Southern peas is raised the trees, and, when ripe, ploughed in to the soil. The trees receive two applications of a year. They grow little the first year; after they become firmly established in the soil, and ... There are no serious diseases of the ... in good soil, in Florida. There are a great ... orange trees, but none so good as the Florida ... or native trees. In starting an orange grove, ... should be cleared of everything, and well ... The holes for the orange seedlings should ... apart, and 18 inches deep, and four feet in ... Consul Cridland states that for a total outlay ... dollars, a person can have an orange grove in ... which will, after the fifth or sixth year, begin ... good income.

...EASANT POPULATION OF SERVIA.

...lation of Servia is about 1,750,000, of whom ... are peasants, living entirely from agri- ... per cent. of the Servian villages range ... 500 inhabitants per village, and 25 per cent. ... 500 to 1,000 per village. It follows, there- ... the peasant population is very much scattered, ... the valleys, villages are not widely distant ... ther, and it may be divided into two schools, ... the new. The peasant of the old school ... cultivates his land in the most primitive ... sible, whilst the peasant of the new school ... lt of the national system of education, under ... ool is now to be found in every considerable ... re advanced on the path of civilisation. ... t of the old school lives in a cottage with ... and mud walls; his live stock consists of a ... a, half-a-dozen pigs, and a small flock of sheep ... his plant comprises a wooden plough, costing ... cat (10s. sterling), a waggon built entirely ... a particle of iron entering into the construction ... ggon or wheels) which cost about three ducats, ... ekira (an axe weighing about 10 lbs.); with ... ecutes the repairs required for the house or ... half-a-dozen hoes for the maize and the ... nd half-a-dozen pruning hooks for the vines; ... e barrels for wine and rakija, and a few ... enware vessels for his goats' and sheeps' ... oxen draw the plough, and he himself guides ... st all the rest of the field work is done by ... d daughters. The thrashing of the corn is ... us:—A piece of ground about 40 feet in ... well trodden down, and a large stake is ... n the middle; a pony is borrowed or hired ... hbouring carrier, and is attached by a long ... stake, the corn in the straw is spread over ... , and the pony is driven round and round till ... nd the cord round the post, he is then driven ... osite direction till he has unwound and ... he cord, and this is repeated till the corn is ... s thrashed out of the straw. The winnowing ... le and very imperfect, it being done by the ... e peasant with a wooden shovel throws ... high up into the air against the ... ch is supposed to carry away the ... clothing of the peasant of the old school ... exception of his fez, nearly all home-made; his wife and daughters spin and weave the cloth of which his shirt, his coat, his "tchaksheri" (broad pantaloons), and his stockings are made. His "opantzi" (sandals) are often made by himself, and his winter coat and cap are generally of sheepskins from his own flock. But the peasant of the old school is rapidly being superseded by the modern Servian peasant, who dates back from the year 1832, when Prince Milosh founded at Kragujewatz the first Servian gymnasium, which was followed in 1843 by a General Education Act, under which, and subsequent Acts, education became general and free, no fees of any kind being payable by the pupils. This might, at first sight, appear to have very little connection with agriculture, but education has exercised a very material influence on the Servian peasant: it has improved his mode of life and his method of cultivation, so that he produces more and spends more, thus contributing more to the exports, and raising the imports of the country. The peasant of the new school builds his house of stone or brick, and furnishes it with a view to comfort, if not to luxury; his land is farmed, too, with some regard to scientific principles, his plough is of modern construction, often entirely of iron and steel. His favourite plough is of wood and iron, for 12-inch ploughing, weighing, with the fore carriage, about 130 lbs., and costing at Pesth about five ducats, or £2 10s., but, on account of the difficulty of transport, there being a total absence of railway communication, only 400 to 500 ploughs are imported annually into Servia, and these are to be found chiefly in the vicinity of the Danube. The modern school of peasants understands, too, the advantage of thrashing by machinery, and a hand-thrashing machine of iron and wood, weighing about 450 lbs., and costing about 25 ducats, or £12 10s., at Pesth, is not unfrequently to be found among his plant; as also a hand-winnowing machine, weighing about 300 lbs., and costing about 10 ducats, or £5, and a maize-rasping machine, for separating the maize grains from the stalk, weighing about 200 lbs, and costing about 10 ducats, or £5. But the interior transport difficulty restricts the import of these machines in common with that of all heavy goods. The modern school of peasants, although clinging to the national costume, with regard to pattern and fashion, is rapidly adopting Western woollen and cotton manufactures as the materials for his clothing, and that of his wife and family, and this fact cannot fail to have a large and increasing influence on the import of woollen and cotton textile manufactures into Servia.

PLANT-LABELS.

The Rev. C. Wolley Dod, of Edge-hall, Malpas, writes to the *Gardeners' Chronicle*, as follows:—

"On going round the herbaceous garden at Kew, it has often occurred to me that the labels are taken up and laid together every time a bed is raked, and afterwards replaced by the labourer from memory, the evident transpositions having seemed difficult to explain in any other way. But after the experience of this winter, when nearly all our flat wooden labels are not only out of the ground, but appear to have been shot out, something in the way in which I have seen porcupines at the Zoological Gardens shoot out their loose quills, so as to be at a distance from the plant which they marked, any amount of demoralisation in the naming of mixed borders can be easily understood. Hence the subject of labels is not unnaturally attracting a good deal of attention at present.

"It may help those of inventive genius who are going to compete for the prize for the best plant-label offered by Mr. G. F. Wilson, through the Society of Arts, if hints are sent by those who have tried different

kinds of labels, so as to give the competitors the full benefit of all past experience. I assume that in all mixed collections of plants a large number of labels is necessary. In my garden, which is of moderate size, I label nothing which can be recognised at all times of the year without a label, and yet I have fully 10,000 labels in constant use. Labels should be (1) cheap, (2) durable, (3) indelible, (4) portable, (5) markable with a common lead-pencil, (6) not liable to be ejected by frost, or (7) broken by a kick.

"Those who have plenty of hazel trees at hand will find hazel rods, three quarters of an inch in diameter, cut into lengths of about 10 inches, with an horizontal slice cutting into 4 inches from the upper end, and made by a single cut of a knife, to take the paint for writing, in many ways better and cheaper than the common flat labels. They last three times as long, or more if the lower end is dipped in creosote. A common labourer with plenty of material, using a pair of pruning-shears and a strong sharp knife, will easily cut 1,000 in a day, and they possess qualities 4, 5, 6, and 7.

I have, however, invented and adopted another label —clumsy I admit, and not readily commending itself to others, but far more simple in practice than it sounds in description. It reminds me of the military regulation order explaining the cocking of a musket, or printed directions given for learning to swim. What reads and sounds as if it were difficult and complicated, becomes in practice the simplest thing in the world. Common round bar-iron, three-eighths of an inch in diameter, is cut obliquely into lengths of 10 inches, and pierced with an eye ½-inch from one end, and dipped when red-hot into gas-tar. For these pegs, which weigh about 4 oz., I pay 50s. per 1,000, but think they might be had for less. Then I have flat wooden suspending labels pierced at each end, for which I pay 4s. 6d. per 1,000; through the two eyes 8 inches of pliant wire is passed, for fastening the label to the iron pin. These are, upon the whole, the most satisfactory labels I have yet used. They cost 5s. 6d. per 100, but the iron pin—nine-tenths of the cost—is indestructible. The label is easily and quickly renewed, and will last, when suspended, for many years. Not one has been ejected from the ground this winter, and if kicked over they are not hurt, and easily set up again. It is true they are heavy to carry about, but I keep a stock of the pins, which are weather-proof, in various corners, so as to have them handy for all parts of the garden.

"Then the wired labels are just as portable and as easily written on as common flat wooden pegs. My great desideratum is a white paint which will reject the splashing of mud, but retain for ever the writing of a lead-pencil. I can get no paint which is perfectly smooth and not sticky when dry, and should be thankful to be told of any. I enclose specimens of what I have described.

"I may add that a heavy plant-label is not altogether without its advantages. In the year 1842, when I was a boy at Eton, one of the many jackdaws which built in the college chapel insisted upon having her nest so arranged that she could, whilst sitting, see out of the turret loophole, which looked towards Windsor Castle. This could only be done by making the foundation on a step of the spiral staircase, nine feet below; and a massive nest, nine feet high, was accordingly built. I made friends with the college clerk, and watched the progress of the nest, and recollect that amongst the materials, besides there being a box of lucifer-matches, garden pegs seemed to be in great request. Three or four years later, when I was at Cambridge, I recollect the present Professor of Botany exhibiting, at a meeting of the Ray Club, a newly-devised label for use in the Botanic Garden there. It was a very heavy metal one —the weight, he said, being found necessary to prevent the jackdaws carrying them up for their nests between *the roofs of* King's College Chapel."

NOTES ON BOOKS.

Electro-typing. By J. W. Urquhart. (
wood and Co., 1881.)

This book is of a similar character to t
manuals which have been issued by the a
of the practical applications of electricit
throughout is to make himself intelligi
who have not much knowledge of scienc
chapters deal with the metals employed
of electricity, describing not only the u
but also some of the machines now so la
electro-plating purposes. Electro-type
positing-vessels, moulding materials, &c.
in succession, while the concluding chapt
deal with the preparation of the work a
treating it after the electro-type process

The Expiring Continent. By A. W
(London: W. H. Allen and Co.,

Under this title Mr. Mitchinson gives
his travels in Senegambia. Mr. Mitchin
time travelling in that country and assoc
people, so that he was in a position
valuable information about them. His c
to take notes of the manners and custom
and of the natural productions of the c
which he travelled. As was the case in t
he read before the Society last year on "
Causes of Disease in Tropical Countries,"
son devoted considerable attention to san
and frequent observations upon them oc
the work. The book has a number of il
also contains a map of the districts trave

Water: its Composition, Collection, and
a Practical Hand-book for domestic a
By Joseph Parry. (London, F. War

The subjects of the chapters into whi
divided are, the composition of water
supply, purification, modern waterwork
waste, rural supplies, domestic supplies,
purposes, and regulations for the pre
and misuse of water. Chapter 6 contain
water rents, rates, and charges, with a t
charged per annum for domestic suppli
towns of Great Britain.

The Wild Silks of India, principally Tuss
Wardle, F.C.S. (London, Eyre and
1880).

This is a reprint by the Government o
paper, read before the Society of Arts,
the *Journal* for May 9, 1879.

OBITUARY.

Professor Tennant, F.G.S.—By the d
Tennant, on the 24th of February last
seventy-three years, the Society of Ar
and active member. Mr. Tennant wa
and afterwards the successor, of J. M
"Travels in Brazil," and of a "Treatise
whose original series of minerals forme
the large collection of metalliferous
logical specimens, and fossil remain
Tennant eventually gathered together.
also possessed a rich collection of
of which the Devonshire collection form

He was, for many years, Professor of Geology neralogy at King's College, London, and after ıg the Professorship of Geology he retained the Professor of Mineralogy, which he held at the his death. In conjunction with the late Pro- Ansted and the Rev. W. O. Mitchell, he wrote, , the "Treatise on Geology, Mineralogy, and lography" for "Orr's Circle of the Sciences." s also the author of descriptive catalogues of and of popular lectures on the sciences in which s specially interested. Mr. Tennant was an ic member of the Turners' Company, and took interest in the action of that company for ex- g Technical Education. He was elected a member Society of Arts in 1846, was a constant attendant eetings, and frequently joined in the discussions, reading a paper on "South African Diamonds," mber 23, 1870.

GENERAL NOTES.

Extinction.—A public exhibition of Dick's teur," and brigade chemical fire-engine, "Excel- as held on Tuesday, 8th inst., on a piece of large nd in Whitehall-place. A fire of wood saturated troleum was lighted, and then immediately extin- by these engines.

ary Assurance.—Dr. F. de Chaumont, F.R.S., ver a lecture on "Sanitary Assurance" at the Institution, Finsbury-circus, on Tuesday, March 3 p.m., in connection with the Sanitary Assurance on. The chair will be taken by J. Eric Erichsen, President of the Royal College of Surgeons. of the Society of Arts will be admitted to the n showing their cards.

id Fine Art Exhibition.—It is proposed to hold a Fine Art Exhibitions at Madrid, to which Spanish ign artists may alike contribute. Works belonging f the following categories, which have received the of the jury, will be admitted:—(1) Paintings, g stained glass, lithographs, wood engravings, ings; (2) Sculpture; (3) Architecture; (4). All which, although not expressly included under any egoing headings, may be considered by the jury, on of their artistic merit, worthy of a place in the Exhi- Works by deceased artists will not be admitted. ition will be held at intervals of three months, com- g in the month of April. Each exhibitor may present ited number works of each class. There will be a in the Exhibition set apart for those works which t been accepted by the jury, but whose authors are, less, desirous of exhibiting them to the public. tion can be obtained by intending exhibitors at the the Spanish Legation, 12, Queen's-gate-place, S.W.

urgh School of Cookery.—The fifth annual of the Edinburgh School of Cookery was held all of the school, Shandwick-place, Lord Provost esiding. The Secretary (Miss Guthrie Wright) read ual report of the Executive Committee, from which s that, during the session 1879-80, the usual courses ns in high-class, plain, cheap, and sick-room were given in the school. Classes were held ous institutions and schools, and two demon- s on sick-room cookery to medical students, in the m, Minto-house. In addition to the ordinary he following have received instruction in the School ery and Domestic Economy:—Thirty-one nurse ners from the Royal Infirmary; eleven girls from n-lane Home; seven girls from Young-street School; public classes were, on application, given in Leven ortobello. In developing the institution into a school stic economy, the committee aim chiefly at providing ching as will render women efficient and useful in mes. The funds show an income during the year of ls. 7d., including a sum of £1,760 17s. 4d. of funds h balances brought from the previous year. The xpenditure has been £944 4s. 9d., leaving funds and ances on hand of £1,972 18s. 9d.

Royal Albert Hall.—The annual general meeting of the members of the Royal Albert Hall Corporation was held on Saturday, 26th February, at the hall, South Kensington, the Right Hon. Lyon Playfair, M.P., in the chair. The Chair- man, in moving the adoption of the report, said it was gratifying to the council to have been able to reduce the hall debt by £1,190, although this had been accomplished rather through the kindness of their creditors than any surplus of money in hand, Messrs. Burchell, their solicitors, having taken six seats at the par value of £100, which was much more than their selling value. They would again find it necessary to ask for a seat-rate of £2 for the current year. They were keeping the hall in a very efficient state of repair, but the profits of the hall had not yet enabled them to dis- pense with that rate. During the year they had an exhibi- tion of fine arts, and its success justified them in recommend- ing another exhibition in the present year. The Council of the Society of Arts also proposed, in connection with the fine art exhibition, to have an art industrial exhibition, and invited art workmen, manufacturers, and others to submit such works in all materials. The formation of a road be- tween the Kensington and Exhibition roads would increase the facilities of access to the eastern entrances of the hall, but even then the approaches would not be all that the council could desire with the view of increasing the attendance at the hall. The system of lighting the hall by electricity had been experimented upon during the year by Messrs. Siemens Brothers, without cost to the corporation. Messrs. Siemens had repurchased part of the apparatus for £310, and as this means of lighting became more perfected they hoped, with the machinery they had retained, to be able to adopt it at a trifling cost. Mr. G. Godwin, in seconding the motion for the adoption of the report, stated that the council would be very glad if the members interested the outside public and the seatholders in the success of the exhibition organised by the Society of Arts. Sir Henry Cole observed with regard to the fine art exhibition that it would probably include a large number of pictures which the Royal Academy had intimated they would have accepted had there been room. The report was unanimously adopted, and subse- quently resolutions were passed requesting the Prince of Wales to act as president of the hall, and re-electing the retiring members of the council.

THE LIBRARY.

The following works have been presented to the Library:—

Some Particulars with reference to the Concession for the Construction of the Great Andino-Argentine Rail- way, from Mercedes to Mendoza and San Juan. (London, 1879.) Presented by Mateo Clark.

Solutions of the Questions in Magnetism and Electricity, set at the Preliminary Scientific and First B.Sc. Pass Examinations of the University of London, from 1860 to 1879, by F. W. Levander, F.R.A.S. (London: H. K. Lewis, 1880.) Presented by the publishers.

The Signature of Gutenberg, by P. de Villiers, M.D. (London: Kerby and Endean.) Presented by the author.

Hastings as a Health Resort, by P. de Villiers, M.D. (Hastings, 1879.) Presented by the author.

Water: its Composition, Collection, and Distribu- tion, by Joseph Parry, C.E. (London: Frederick Warne and Co., 1881.) Presented by the publishers.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock:—

MARCH 16.—"The Beaumont Compressed-Air Loco- motive. By Col. F. BEAUMONT, R.E.

MARCH 23.—"The Increasing Number of Deaths from Explosions, with an Examination of the Causes." By CORNELIUS WALFORD.

MARCH 30.—"Recent Advances in Electric Light- ing." By W. H. PREECE.

April 6.—"The Discrimination and Artistic Use of Precious Stones." By Professor A. H. Church, F.C.S.

April 27.—"Five Years' Experience of the Working of the Trade Marks' Registration Acts." By Edmund Johnson.

Dates not yet fixed:—

"The Manufacture of Glass for Decorative Purposes." By H. J. Powell (Whitefriars Glass Works).

"Buying and Selling; its Nature and its Tools." By Professor Bonamy Price, M.A. Lord Alfred S. Churchill will preside.

"The Electrical Railway, and the Transmission of Power by Electricity." By Alexander Siemens.

Foreign and Colonial Section.

Tuesday evenings, at eight o'clock:—

March 15.—"Diamond Fields of South Africa." By R. W. Murray.

April 5.—"Canada; the Old Colony and the New Dominion." By E. Hepple Hall.

May 10.—"Trade Relations between Great Britain and her Dependencies." By William Westgarth.

Applied Chemistry and Physics Section.

Thursday evenings, at eight o'clock:—

March 24.—"The Future Development of Electrical Appliances." By Prof. John Perry.

May 12.—"Recent Progress in the Manufacture and Applications of Steel." By Professor A. K. Huntington.

Indian Section.

Friday evenings, at eight o'clock:—

March 25.—"The Tenure and Cultivation of Land in India." By Sir George Campbell, K.C.S.I., M.P.

May 13.—"Burmah." By General Sir Arthur Phayre, G.C.M.G., K.C.S.I., C.B.

Members are requested to notice that it may be necessary to make alterations in the dates of the above papers.

Cantor Lectures.

Monday evenings, at eight o'clock:—

The Third Course will be on "The Scientific Principles involved in Electric Lighting," by Prof. W. G. Adams, F.R.S. Four Lectures.

Syllabus of the Course.

Lecture II.—March 14.

The measurement of electric currents. Efficiency of magneto- and dynamo-electric machines. Heating effects of the current.

Lecture III.—March 21.

Use of magneto- and dynamo-electric machines for electric lighting. Electric lighting by means of the arc.

Lecture IV.—March 28.

Subdivisions of the electric current. Incandescent lamps. Luminous effects of electric currents in a vacuum, and in various gases.

MEETINGS FOR THE ENSUING WEEK.

Monday, March 14th...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Professor W. G. Adams, "The Scientific Principles Involved in Electric Lighting." (Lecture II.)

British Horological Institute, Northampton-square, E.C., 7 p.m. Mr. John Standfield, "Cheap Patents and Prosperity."

Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. Mr. James Stewart, "Lake Nyassa and the Water-route to the Lake Region of Africa."

British Architects, 9, Conduit-street, W., 8 p.m. Special *General Meeting* to elect Royal Gold Medallist, and to *receive Council* Report on Medals.

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.(G. Phillips Bevan, "The Gold and Silv World."

Tuesday, March 15th...**SOCIETY OF ART** Adelphi, W.C., 8 p.m. (Foreign and C Mr. R. W. Murray, "The Diamond Africa."

Royal Institution, Albemarle-street, W., A. Schäfer, "The Blood." (Lecture I

Civil Engineers, 25, Great George-street S.W., 8 p.m. 1. Renewed discussion u Thomson's paper on his "Tide-gauge, Analyser, and Tide Predicter." 2. Mr. "The Comparative Endurance of Iron when exposed to Corrosive Influences."

Statistical, Somerset-house-terrace, Stran Mr. Hyde Clarke, "The Progress Stations in the Hill Regions of India."

Pathological, 53, Berners-street, Oxford-st

Zoological, 11, Hanover-square, W., 8½ p.n

Wednesday, March 16th...**SOCIETY OF AR** Adelphi, W.C., 8 p.m. Colenel F. B Beaumont Compressed-Air Locomotive

Meteorological, 25, Great George-street 1. "Exhibition of Hygrometers an Meteorological and other Instrument brought out since January 1st, 1880." Sketch of the different classes of Hygr President, who will also describe su exhibited.

Public Analysts, Burlington-house, W., C. Heisch, "The Swedish Acts for re of Poisons." 2. Mr. Bernard Dyer, " of Milk." 3. Mr. J. West Knights, " for the Estimation of Nitrates in Pota Mr. J. Carter Bell, "Samples of Milk w below the Society's Standard."

Archæological Association, 32, Sackville- 1. Dr. James Stevens, "Recent Discove 2. Mr. Henry Prigg, "Roman Pottery Stow."

Royal College of Physicians, Pall-mall E (Gulstonian Lecture.) Dr. Couplan (Lecture II.)

British Horological Institute, Northampt 8 p.m. Mr. Curzon, "The Lever correct Principles and common Faults."

Thursday, March 17th...Royal, Burlington-hou

Antiquaries, Burlington-house, W., 8½ p.

Linnean, Burlington-house, W., 8 p.m. Watt, "The Indian Species of *Primul* Boog Watson, "Mollusca of *Challe* 3. Mr. B. Daydon Jackson, "Note on Linn., and Certain Allied Species."

Chemical, Burlington-house, W., 8 p. Brown, "The Volumes of Mixed Liqu Jones, "Boron Hydride." 3. Mr. F. Edgar Wilcock, "The Action of Aldeh thraquinone in Presence of Ammonia Jupp and Mr. H. J. N. Miller, "The A Acid on Napthaquinone." 5. Mr. R. W Alleged Formation of Nitrous Acid poration of Water." 6. Prof. Hartley, of Solar Rays by Atmospheric Ozone Tint of the Atmosphere." 7. Mr. C. Mr. E. H. Rennie, "Note on the Sw Smilax Glycyphylla."

London Institution, Finsbury-circus, E. W. H. Stone, "The Combination of Vo ments" (with illustrations).

Royal Institution, Albemarle-street, W., Statham, "Ornament Historically and sidered." (Lecture I.)

Royal Historical, 11, Chandos-street, W.

Numismatic, 4, St. Martin's-place, W.,

Philosophical Club, Willis's-rooms, St. 6½ p.m.

Civil and Mechanical Engineers, 7, Westm S.W., 7 p.m. Mr. R. E. Middleton, " and Sewerage."

Royal National Lifeboat Institution, Meeting at Willis's Rooms, St. James'

Friday, March 18th....Royal College of Phys East, S.W., 5 p.m. (Gulstonian Lect land, "Anæmia. (Lecture III.)

Royal United Service Institution, White Captain C. W. B. Bell, "The Cavalry; Screening, and Outpost Duties."

Royal Institution, Albemarle-street, W. H. Stone, "Musical Pitch and its Det

Philological, University College, W.C., Postgate, "Latin and Greek Derivatio

Saturday, March 19th...Ladies' Sanitary As House of the Society of Arts), Richardson, "Domestic Sanitation or (Lecture V.)

Royal Institution, Albemarle-street, W. R. Haweis, "American Humorists."

OF THE SOCIETY OF ARTS.

No. 1,478. VOL. XXIX.

'DAY, MARCH 18, 1881.

…s for the Society should be addressed to the Secretary …ohn-street, Adelphi, London, W.C.

NOTICES.

CANTOR LECTURES.

…d lecture of the third course was … Monday, 14th inst., by Professor W. …F.R.S., on "The Scientific Principles … Electric Lighting." The subjects …alt with in the lecture were the … of electric currents, the efficiency of …d dynamo-electric machines, and the …ts of the current. These were illus… series of experiments. The lectures …hed during the summer vacation.

ALBERT MEDAL.

…l will proceed to consider the award … Medal for 1881, early in May next. …as struck to reward "distinguished …noting Arts, Manufactures, or Com… has been awarded as follows:—

… Sir Rowland Hill, K.C.B., F.R.S., "for …rice to Arts, Manufactures, and Com… creation of the penny postage, and for …ms in the postal system of this country, … which have, however, not been confined …y, but have extended over the civilised …

…is Imperial Majesty, Napoleon III., "for …merit in promoting, in many ways, by his …ions, the international progress of Arts, … and Commerce, the proofs of which are … judicious patronage of Art, his enlight…al policy, and especially, by the abolition … favour of British subjects."

… Professor Faraday, D.C.L., F.R.S., for …n electricity, magnetism, and chemistry, … relation to the industries of the world, …ly promoted Arts, Manufactures, and …

… Mr. (afterwards Sir) W. Fothergill Cooke … (afterwards Sir) Charles Wheatstone, …cognition of their joint labours in estab…t electric telegraph."

… Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For. Memb. R.S., Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. (now Sir) Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. (now Sir) Henry Bessemer, F.R.S., "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Michel Eugène Chevreul, For. Memb. R.S., "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

In 1873, to C. W. Siemens, D.C.L., F.R.S., "for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvement in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to the Manufactures and the Arts."

In 1875, to Michel Chevalier, "the distinguished French statesman, who, by his writings and persistent exertions, extending over many years, has rendered essential service in promoting Arts, Manufactures, and Commerce."

In 1876, to Sir George B. Airy, K.C.B., F.R.S., Astronomer Royal, "for eminent services rendered to Commerce by his researches in nautical astronomy, and in magnetism, and by his improvements in the application of the mariner's compass to the navigation of iron ships."

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., member of the Institute of France, "the distinguished chemist, whose researches have exercised a very material influence on the advancement of the Industrial Arts."

In 1878, to Sir Wm. G. Armstrong, C.B., D.C.L., F.R.S., "because of his distinction as an engineer and as a scientific man, and because by the development of the transmission of power—hydraulically—due to his constant efforts, extending over many years, the manufactures of this country have been greatly aided, and mechanical power beneficially substituted for most laborious and injurious manual labour."

In 1879, to Sir William Thomson, LL.D., D.C.L., F.R.S., "on account of the signal services rendered to Arts, Manufactures, and Commerce by his electrical researches, especially with reference to the transmission of telegraphic messages over ocean cables."

In 1880, to James Prescott Joule, LL.D., D.C.L., "for having established, after most laborious research, the true relation between heat, electricity, and mechanical work, thus affording to the engineer a sure guide in the application of science and industrial pursuits."

The Council invite members of the Society to forward to the Secretary, on or before the 23rd of April, the names of such men of high distinction as they may think worthy of this honour.

LABEL FOR PLANTS.

The Council are prepared to award a Society's Silver Medal, together with a prize of £5, which has been placed at their disposal for the purpose by Mr. G. F. Wilson, F.R.S., for the best label for plants.

The object of the offer is to obtain a label which may be cheap and durable, and may show legibly whatever is written or printed thereon; the label must be suitable for plants in open border. These considerations will principally govern the award.

Specimen labels, bearing a number or motto, and accompanied by a sealed envelope containing the name of the sender, must be sent in to the Secretary not later than the 1st May, 1881.

The Council reserve to themselves the right of withholding the Medal and Prize offered, if, in the opinion of the judges, none of the specimens sent in are deserving.

PROCEEDINGS OF THE SOCIETY.

FOREIGN AND COLONIAL SECTION.

Tuesday, March 15th, 1881; HARRY ESCOMBE, Member of the Legislative Council of Natal, in the chair.

The paper read was on—

DIAMOND FIELDS OF SOUTH AFRICA.

By R. W. Murray.

Seeing how little is known of South Africa, its people, and natural resources here in England, and how much this country, as well as its rich and vast colonial dependency, has lost, and is still losing, through the lack of such knowledge, it becomes the duty of every man who is informed upon South Africa, its public affairs, its soil, climate, resources, and people, to impart all the information upon these that he can whenever a suitable opportunity presents itself.

Few men who have made themselves thoroughly acquainted with South Africa, whatever opinions they held before visiting it, but are convinced that it is destined to become a great country—English colonists hope, a most important portion of the British Empire.

It is not long since you heard from Sir Bartle Frere, in this very room, how rich and varied are the industrial resources of South Africa. That gifted lecturer has, since his return to England, devoted himself most arduously to his self-imposed task of making South Africa better known to his fellow-countrymen, and to him the people of South Africa will feel more than ever attached, if that be possible, when they come to see how much he has done for them upon English platforms.

I am not about to lecture on the general characteristics of South Africa, but to bring, as far as I can, into the prominent notice it deserves to have, that *part of the* South African continent in which I have spent the last ten of the twenty-se have been in the country.

Whilst very little is known in En portion of South Africa, the Diamond l least known, and have, I think, been presented, and yet no single spot of g whole world is better worth knowin are. I have held, and still hold, that of modern times is more remarkable the Diamond Fields of South Africa; n her Majesty's dominions has made suc gress in civilisation and wealth, and progress of the province of Griquala which the Diamond Fields are situate by misgovernment, it will be one centres, if not the chief centre, of tra merce in that great country.

I shall not weary you with any sp theories regarding the formation of t or take up any of the time allotted t troducing any of the questions re geological formations of this territory from time to time, been discussed in world. I shall but a plain, unvarnishe of its history, from the time of it to the present hour, endeavouring t how vastly it has contributed to the w world, how much it is still contributi an extraordinary manner it has been civilising the native tribes of the coun important part it has played in th South Africa during the last ten years

In the first place, as to the disco Diamond Fields, it is necessary to me 1867, the Cape Colony and Natal w most acutely from financial and depression. The Free State had had of fighting against its native neig Basutos, and its indebtedness to the (and Natal had hardly come to be to be of any worth to colonial cred general bankruptcy throughout S appeared inevitable.

The public works which had been the Cape Parliament had been stopp the other; the engineers and navvies, from England for railway constru most of them, out of employ. The s merchants in Cape Town, Port Grahamstown, and the other principa centres of trade, as well as those of glutted with stocks, which were not off. The life of South Africa appea gone out of it. The farmers had n on their estates, until, one after the once well-to-do, went into the *Gazette*; was the state of affairs in the wester the Cape Colony, that many a man w a producer of cereals all his life, had to meal for his family use.

The chief cause of this dire di from the long series of droughts to country had been subjected. So bad of things, and so helpless had everyth that many families, who could comm enough to pay their passages, left the other shores.

In the course of that year, 1867, ju were at the very worst, and men h regard the whole of South Africa as G

Mr. John O'Reilly, a trader and hunter in the interior, was in Albania. Here I had better explain that Albania is a portion of the province of Griqualand West. It was a portion of the territory of the Griquas, who were under the chieftainship of Nicholas Waterboer, who afterwards ceded his territory to the British authorities. That territory, which became a Crown colony, and in which are the diamond diggings and mines, is situated between the Cape Colony, the Free State, the Batlapin territory, and that which is set down in the old maps as occupied by Hottentot tribes, and in which the copper mines are found. I shall endeavour to avoid embarrassing you with more of such details than are unavoidable. The latitude and longitude are not at all essential to the subject with which I am dealing. It will be sufficient for you if I state that Griqualand West is about 600 miles from each of the sea ports, and that it is approached by various routes; those most frequented are the western, or Table Bay route, the eastern, from Port Elizabeth, the frontier, or the East London route, and the Durban or Natal route.

Albania, of which I commenced to speak, was a portion of the Griqua territory, settled by colonists, under terms made with Waterboer, some two years before the discovery of diamonds had been heard of. One of the colonists who had helped to form the settlement was a Mr. Van Niekirk. Mr. O'Reilly, who was returning from the interior to Colesberg, called upon Van Niekirk, and remained with him the night. In the course of the evening, one of Van Niekirk's children, a little girl, was playing on the floor with some of the pretty stones which are common in the neighbourhood of the Vaal River. Mr. O'Reilly's attention was attracted to one of the stones, which threw out a strong light, to which Mr. O'Reilly's eyes had been unaccustomed. He took it up from the floor and offered to buy it, asking what Van Niekirk would take for it. The simple-minded Boer could not be made to understand what the meaning of buying a stone could be, and he said he would take no money for it, but that if Mr. O'Reilly had a mind to it, he could have it.

The colonial trader is generally represented as a character of a most designing and unscrupulous nature, but there are men amongst them whose right dealing and high character would stand comparison with those of any men in the world, and no men are on better footing amongst the Boers than the established traders. Mr. O'Reilly is one of these. He told Van Niekirk that he believed it to be a precious stone, and of value; he would, therefore, not take it for nothing. It was ultimately agreed between them that O'Reilly should take the stone, ascertain its value, and, if found to be a diamond, as O'Reilly suspected it was, that it should be sold, and the money divided between them. Mr. O'Reilly took the stone to Colesberg, where he showed it, and he confidently stated to the people he met at the bar of the hotel that it was a diamond. He wrote his initials on the window-pane and cut a tumbler with the stone, and was laughed at for his alleged foolishness, as many a discoverer had been before him. One of the company took the stone out of O'Reilly's hand and threw it into the street. It was a narrow chance that the stone was found again, and, had it not been, it is quite a question whether the Diamond Fields of South Africa had yet or ever been discovered in our day. However, the stone was found, and O'Reilly sent it to Grahamstown, to Dr. Atherstone, to be tested, and the doctor and Bishop Ricards, the Roman Catholic Bishop of Grahamstown (one of the most scientific men in South Africa) both pronounced it to be a diamond of 22¼ carats. From Grahamstown the stone was sent to the then Colonial Secretary, the Hon. Richard Southey, afterwards the Lieutenant-Governor of Griqualand West, who submitted the stone to the best authorities at hand, and they all decided it to be a diamond. It was then forwarded to the Queen's jewellers, Messrs. Hunt and Roskell, who confirmed the decisions obtained in the colony, and valued the stone at £500. At this valuation, it was purchased by his Excellency, Sir Philip Wodehouse, who was Governor of the colony at the time. Mr. O'Reilly, as soon as he had ascertained for certain that his first stone was a diamond, set out to see if he could not find others, and was not long before he found one of 8 carats and ⅞, and this too was purchased by Sir Philip Wodehouse for £200. This led to a good deal of excitement throughout the country. Small diamonds were brought in by natives. Then flashed the startling intelligence through the country, that a diamond of over 83 carats had been discovered. This turned out to be true, and this is how it came about. Mr. Van Niekirk, from whom Mr. O'Reilly obtained the first stone, hearing that it had turned out to be a diamond, remembered that he had seen one of a similar character in the possession of a native, and set out to find it. A Boer is not long in getting hold of a native when he wants him, and Van Niekirk soon had his man. The native had kept the stone, and Van Niekirk gave him nearly all he possessed for it—about 500 sheep, horses, &c.—but at whatever the price, he obtained the stone, and set off with it to Messrs. Lilienfield Brothers, of Hopetown, merchants of long standing in South Africa, and now represented in Hatton-garden. They purchased the stone for £11,200, and christened it "The Star of South Africa," forwarded it to England, and it ultimately became the property of the Countess of Dudley, who purchased it of Messrs. Hunt and Roskell.

That all this would have a great effect upon communities, whatever their conditions and prospects in life, no one will have the least difficulty in believing, but the excitement it did create amongst the various communities of South Africa, who were at that period on the verge of bankruptcy, it would be difficult to convey to you. It is said that drowning men catch at straws, and I have no doubt that that proverb is well founded. But it is one thing for a drowning man to catch at a straw in his last extremity, and another for him to be inspired by faith to rise and walk upon the water. The people, who almost despaired of the country or themselves being restored to prosperity again, wanted to see the prints of the diamonds on the hill-sides from which they had been taken. They did not deny that the diamonds had come to Cape Town, nor that they had been sent to England, nor that they had been sold for much money. Some had seen the diamonds, others had seen men who had seen them, and, besides, Sir Philip Wodehouse had purchased two and paid his money for them, and the word of Sir Philip Wodehouse was at that time a

law unto all South Africa. Where did the diamonds originally come from? That was what they wished to know. They were out of love with the Cape, and it was with the old colony as it was with Nazareth, men shook their heads and asked each other "Can any good come out of it."

They at first, of course, denied that there were any diamonds. Then, when they could do that no longer, they said that they had not been found in South Africa. At last, they not only thought, but said, that the whole thing was a plot of the Hope Town and Colesberg owners of land to send up the price of their land, and that they had imported the diamonds from the Brazils. What wonder that this should be said, when an authority on such matters, who was sent out by one of the first dealers in precious stones in the known world to spy out the land, after making a tour through it, and a scientific survey of it, reported most dogmatically that there could be no diamonds found in the country, and gave his "reasons why." A letter appeared in one of the leading journals, duly signed by this great authority in diamonds, in which the writer settled, to the satisfaction of those who previously doubted the validity of the diamond finds, that South Africa was non-diamondiferous.

What do we not get settled for us by authorities in the leading journals? Alas! for some of the authorities, the result of their settling affairs of politics, sciences, and art is much the same as in the case in point. Whilst the print was fresh which conveyed the decision to the world that no diamonds could ever be found in South Africa, intelligence arrived in England that good parcels of diamonds had been secured by several well-known persons.

At the end of 1868, the more enterprising of the colonists pushed their way up to the Vaal River, where it was supposed the diamonds had been found. There has always been much discussion as to who were the first in the field. I have taken pains to discover, and I think there can be no doubt that the first party who went up from the colony to search for diamonds was formed in Bethulie, headed by the late Mayor of Kimberley, Mr. J. B. Robinson, and that the next came from Natal, the men of which colony have always been famed for their enterprising character. It was not, however, until about Christmas, 1869, that the general movement commenced, and, at that time, a party from King Williamstown (British Kaffraria) passed through the Free State. They made no secret as to their destination or purpose, and were thoroughly ridiculed when they said they were going to search for diamonds along the banks of the Vaal River. When the Bethulie party first arrived, they had no idea of digging for diamonds; they considered, like many other people, that diamonds fell "like the gentle dew from heaven upon the earth beneath."

When they arrived, they found on the banks of the Vaal, half-way between the Berlin Missionary Station and a place called Hebron, where the first diggings were established, a native who had a diamond in his possession. He had heard that it might be a diamond, and he had wrapped it up in several dirty bits of rag, and tied it up, but he never suspected that he was to get eight golden sovereigns for it as he did. Of course, the rumour *that such stones* were worth so many sovereigns soon got noised abroad, for the first thin[g the] native who had all this money did, was to [give a] jollification to his sisters, and his cousin[s, his] uncles, and his aunts, and the jollification [lasted] over some ten days, brought together [natives] (chiefly Koranas) from far and near. The[se] were set looking for diamonds along the ri[ver and] the hills, and they found well. Some [...] hundred were soon at this work, and the [...] party sent into the colony, realised their p[...] and brought Basutos up to work expre[ssly for] them. The party settled on a farm the[y called] Livingstonia, near Hebron.

No thought of digging for diamonds ap[pears to] have occurred to any one until the arrival [of a] party from Natal, one of whom had been a digger in California and Australia. His id[ea was] to sink a shaft; that, however, was a failur[e ...] the digging out of the diamondiferous soil, cradling it for diamonds, just as in gold-se[eking,] was adopted, and the principle of which ob[tains] to this day.

Whilst the parties I have mentioned were op[erat]ing on the banks of the Vaal near Hebron, [a] Kaffrarian party crossed the Vaal lower d[own,] and settled themselves at a place called Klip[drift,] where they picked up diamonds too. They, [hear]ing that there was a party up the river fi[nding] well, went up there, and, by the time they reached Hebron, they found that other partie[s had] come from Natal, and others were on their [way.] In a month or two after, there were hundreds [and] hundreds of wagons loaded with diamond-se[ekers] on their way from all parts of South Africa, [...] for the Vaal River. At the first, all the dia[monds] were found on the side of the river furthest [from] the Cape Colony. About the middle of 18[70, a] large number of wagons of colonial Boer[s and] colonists arrived at Pniel, which is the name of [...] on the colonial side of the river, and the Boe[rs and] colonists to whom the wagons belonged, disc[over]ing that the river was "down"—which means t[hat it] was too deep to be crossed—outspanned there[, and] as the river remained unfordable for over a [fort]night, some of the Boers and others thought [they] would dig, and see if there were no diamo[nds to] be found on that side of the river as well as o[n the] other. They did so, and were soon rewarded [with] diamonds, which they—at the time, not kno[wing] anything about cradling—picked out of th[e soil] which they dug up. But for the Vaal River ha[ving] been unfordable, the Pniel diggings might [not] have been discovered. The majority of those [who] had outspanned at Pniel never crossed the ri[ver to] Klipdrift to dig, but remained where they [were,] and a camp was formed there. This was the [origin] of the famous Pniel Diggings, out of [which] hundreds and hundreds of men made fort[unes.] Klipdrift was at the time considered no [man's] land; the chief, Jantje a Koranna, was suppo[sed to] have the most right to it, and he himself al[ways] told the diggers that that territory belong[ed to] him, and he took a good deal of money for [...] from the diggers which, of course, they neve[r ...] On the Klipdrift side no money was paid fo[r the] right to dig. Pniel was and is the property [of the] Berlin Missionaries, held under a grant fro[m the] Free State Government. Ten shillings a [...] was paid for digging there, and that money, [the] diggers paid it, the Berlin Missionaries rec[...]

wholly or in part—I am not sure which. ...tember, 1870, the Pniel camp had become a ...a canvas town, as a matter of course, and Klipdrift side a canvas town had also sprung ...n 1870, there could not have been less than ...ules at work on the Pniel side of the river, ...00 on the Klipdrift side; Hebron was as

...at many diamonds were found, but it is a ...ion whether, up to September, 1870, the ...and fields gave a profit on the outlay ex...ed on them. A good many men had made ...sums of money out of the diamonds they ...for the price then paid was greatly in excess ...which diamonds now realise. I shall go on ...an outline history of the diamond diggings, ...ow how they sprung into existence, before ...h the land disputes which arose. As the ...crowded in, and elbowed each other in ...gerness to get claims, the necessity for some ...overnment was felt. The first effort to en...r and order was made by the diggers them... Diggers' protection societies were formed, ...mittees were appointed. On the Klipdrift ...committee not only dealt with the differ...ween the diggers, but it also administered ...nd I, looking back over the difficulties of ...ion, and remembering how large a pro...f the community was made up of men ...or a long time been wandering about the ...oking for employment, and not finding ...ound to say that, on the whole, justice as ...l as is to be had in our English courts ...istered there, and order was fairly well ...l. This must be attributed to the ...there were, on the Klipdrift side, a ...number of men who had been accus... public life in England and in the They kept the turbulent spirits in ...d punished offences against law and ...h a firm hand. The Klipdrift com...s composed of Englishmen—that is to ...glish-speaking men. They had either ...he colony from England, or they were the ...s of English parents who had settled in ...Colony or Natal. The members of that ...had resolved amongst themselves that ...of the river should remain English. ...e some Boers amongst the crowd, but ...as desirous that British rule should be ...as were their English neighbours. This ...enerally the case when the intelligent ...Boer is not under the influence of Afri...other agitators.

...e State had sent down a magistrate from ...ein to administer justice in that camp. The ...Government had sent down a magistrate ... The latter Government, with a keen ...ritory, appointed a gentleman to sit as ...at Klipdrift, but the Klipdrift diggers ...understand that the Transvaal Govern...not, and never would have, any control ...place. The men of Klipdrift, who led ...n most things, quietly conducted the ...nominee to a boat, and put him across ...eaving him on the Pniel side. This was ...their mode of dealing with men who ...wanted. By October, 1880, the camps ...ming with population. New rushes were ...ong the river, and as soon as any new rush was discovered, many of the diggers, who had been doing well before, left their claims and went off to the new places. Men who take to gold or diamond digging are never the sort of men to let well alone. They start on their enterprise with the idea that they are to get rich quickly, and their riches never come fast enough to hand. The *bonâ-fide* rushes down the river yielded, in some cases, more diamonds per individual digger than did Pniel, Klipdrift, or Hebron, and there were amongst those who operated at each place men who, from being next to penniless, soon became well off.

It was at one of these minor diggings down the river—not, however, discovered until 1872—that Mr. Spalding's diamond of 288½ carats was found. Although this diamond was 205½ carats heavier than the "Star of South Africa," it did not bring to the finder much more than half the amount of money paid by Mr. Lilienveldt for the "Star" which created the first excitement.

The men who came to sell and not to dig, seeing how eager the diggers were to get to new rushes, very soon commenced to turn that weakness to account. The schemers, who had on hand large stocks of wines and spirits sent from the colony, selected spots at some distance from the old-established diggings, and commenced digging, they themselves whispering to others that they had "found" there, and sometimes would show some fine stones which they said they had taken out at a foot or two deep. As soon as this was known, there would be a rush of diggers from the old spots to the new one, and every digger would mark out a claim for himself. Whilst this was doing, a canteen would be started, and, as men cannot dig long in a climate where it is frequently 110° in the shade, the canteen man drove a lucrative business. For some time this game answered very well. There would, as a rule, be a hundred or two diggers assembled at the new rush, all bent upon digging, and they would go on digging for a week or a fortnight before they found that the new rush was of no account, by which time the canteen keeper would have sold off all the stock he had originally of his own, and, in many cases all he could buy up in addition thereto. When the patience of the diggers was exhausted, so would his stock be; and he would then lower his tent, and go back with the diggers, deploring that the new rush had not answered. I need hardly tell you that the canteen-keeper was either the discoverer of this "rush," or an agent of his was. After a time, but not for a long time, the canteen rushes ceased to draw. Those who stuck to their claims in the first established diggings did best for themselves, as a rule, and the men who traded fairly with the steady-going digger did best in the long run.

At one time it was thought that there would be a difficulty in getting provisions and supplies, but the stock-breeder, and the butcher, and the baker, and the store-keeper, soon followed upon the grand army of diggers, and shops, supplied from the stores of the merchants in the Cape Colony and Natal, increased and multiplied as fast as the population. There never was any want of food or digging appliances at any time, although the fare was hard and coarse, and such as few of those I am now addressing would be inclined to put up

with for any amount of money. The stocks which had for several years laid heavily on the hands of the colonial merchants in the port towns, found a ready market, and the depression which, before the discovery of diamonds, had driven half the merchants in the Colonies to distress, desperation, and, in some cases, to bankruptcy, gave place to cheerfulness and enterprise, and trade in South Africa became brisk. The spirit of enterprise was quickened. The merchant increased his importations from England. The English manufacturers of picks, shovels, wheelbarrows, and corrugated iron, soon shared in the advantage of the new discovery, and the Customs returns of the Cape Colony, which had fallen very low, showed such a marked increase as they had never done before in so short a time. To give you an idea of the marked effect which the discovery of the Diamond Fields had upon trade and customs, I may remark here that the import duties which, in 1869 (the year in which diamond digging was first started), were but £1,953,091, had risen by the end of 1871 to £2,585,298; whilst at the end of 1879 they had risen to £7,080,229. With this aspect of Diamond Field history, I purpose to deal later on.

It was a remarkable feature of the Diamond Fields, in the first period of their history, that such crowds of men should have worked side by side with so little outrage. Crime of a serious kind was seldom committed. There was none of the outbreaks which in California, in the early days of digging for gold there, called the Vigilantes into existence. In that country it became necessary, for the sake of life and property, to keep a body of men with loaded revolvers in their belts—a stern necessity—and bands of ruffians were shot down without mercy. On the Australian gold-fields, blood-shedding had to be resorted to, and in the history of gold-digging in that country, occur records of brutality little less horrible than in the historical records of California.

The Californian diggings, in their earliest days, were the resort of the off-scourings of America and elsewhere. The great mass of the men who crowded the banks of the Vaal—indeed, I may say nearly all who first arrived there to dig for diamonds—were colonists, the most of whom had occupied positions in which character was indispensable. A very large proportion of the diggers of 1870, who operated on the banks of the Vaal River, were colonial born men from the frontier districts of Natal, either men who left their farms, or their businesses, or professions in the frontier towns. Those who formed these parties were most usually related to each other in some way—either by blood or business. Then a good many military men, who happened to be in the country at the time, obtained leave of absence, and joined in the rush. The first persons who came into the fields from Natal were Messrs. Glennie and King. They joined the Bethulie party, headed by Mr. Robinson, of the firm of Robinson and Marcus, of London and Kimberley, who opened up the diggings on Livingstonia (afterwards Robinson) and Hebron. Glennie had been a gold-digger in California and Australia, and he first introduced digging and cradling. Up to the end of 1870, very few persons had come from other countries to dig for diamonds.

In South Africa, as in all other parts of the world, there are men who never work until t are compelled, and who are incorrigible irrestrainable. There are far fewer of these in South Africa than in any other countr have yet seen, but still, they are even plentiful in South Africa. They cannot long in idleness and debauchery in the to hence they make their way to the farms, obtain a living amongst the Boers. At the towns the worst of them are found; but there not a great many port towns in South Africa the Diamond Fields are too far from the po be easily reached by such men as those I spe However, by about October, 1870, from the po the farms there came, amongst the thousand were swarming the banks of Vaal River, a ho or two of the restless, rowdy, worthless men never care for any settled employment. But never had the least chance of getting the hand at any of the camps. The moral force bulk of the diggers was sufficient to silence idle and unruly whenever they became The Diamond Fields, however, had not been in existence before parties sprung up. It curious to see how men became ambitious for and power in that outlying region, just as in England, America, France, and elsewhere; it was in the contentions and conflicts of such that the unruly element became dangerous. were always ready to back anyone who would or stand drinks, and would as soon shout Transvaal magistrate as an English, for a pres as for a diggers' protection association. It w one to them—they only cared for who paid be who would "stand Sam" the more readily. At and Hebron, the Englishman and the Dutch worked side by side without any considerati nationality. In five cases out of ten, the Eng man did not understand one word of Afric Dutch, nor the Boer a single word of Engli that if they did quarrel, it could not be a " and a blow." Whilst, however, individuals w along together pleasantly enough without reg nationality, there was a good deal of feeling out of the different nationalities which go the several camps. For instance, Pneil was und flag of the Orange River Free State. Hebron under the flag of the Transvaal Republic, and drift under no flag whatever, but the English fl understood to be the Klipdrift flag. The Tra would have liked to have taken possession of drift, and did try. The Dutch element at were equally eager with the Transvaalers t possession, and both did attempt it. The Tra Government, as I mentioned before, did s magistrate, but he was put across the river. magistrate at Hebron put an Englishma prison because he refused to pay a 10s. lice dig, and the Klipdrift men, that is the m that side of the river, armed themselves, and up and forced the magistrate to liberate his soner, and made his worship entertain the tion army into the bargain.

It no doubt kept the republican element when it became known that the subjects Majesty in the Fields had memorialised. Lieut Governor Hay, then acting as High Commi and Governor of the Cape Colony, to ass Queen's authority on the banks of the Vaal that his Excellency had sent back a favo

...wer. In those days the power of England was ...me, wherever it dared assert itself, in South ...ia, and the word of whoever represented the ...wn was as law to men of all nationalities and ...

...en I said that there was a desire amongst the ...h element on the Pniel side to have possession ...lipdrift, I must be understood not to mean ...the President of the Free State, representing ...State, had any such design. On the contrary, ...conversation I had with him at the Presidency, ...ontein, in about August, 1870, he distinctly ...me that the Free State had no claim what... upon the land on the Klipdrift side of the ... but the Dutch Boers, I mean the majority of ...one meets with in that territory, so far re... from the sea, look upon themselves as ...ightful owners of all lands they can come ..., which are only occupied by natives. ...ritish Government, as I presume you are ..., did make, at the close of 1870, some ...that it intended to protect its subjects who ...operating in thousands along the banks of ...aal. The chief Waterboer had solicited the ...entative of the Crown, years before that ... to take him and his people under its pro...t. It has been said, and very many times ...d, that the British Government would never ...ared whether the Free State or Waterboer ...e land in dispute between them, but for the ...ry of diamonds in the disputed territory. ...g can be further from the truth than is this, ...rence to Blue-books and other docu... will prove. Years before the discovery of ...ds, Sir Philip Wodehouse, whilst High ...sioner and Governor, had taken action ... matter, in consequence of the encroach... of the Boers upon Griqua territory. ...oer had tendered his country to the ...ment, also years before, and his people had ...en anxious to be under the Government of ...en. In 1870, when the memorial was sent ...t.-Governor Hay, then Acting High Com...er and Governor, to take the Diamond ...under his protection, Waterboer was quite ...ous as the memorialists that the British ...ment should do so. But neither the ...al Government nor the High Commissioner ...y power to hoist the British flag over new ...y, and much time was lost before anything ...er was done in the matter. At last, how...t was decided to send up a special magi... appointed by the High Commissioner, ...inister law and justice under the authority ...iqua chief.

...e now given you an outline history of the ... of the Fields, and of what I consider to be ...st phase in their history. I shall endeavour ...up, stage by stage, until I reach the present ..., when art and industries have obtained ...ent and secure footing there.

...ard the arrival of the special magistrate ...Diamond Fields as the commencement of ...era in their history. His arrival was hailed ...glishmen on both sides of the river with un...d satisfaction.

...as a novel sight to see an English magis...olding an appointment under the com... authority of the Crown of England and ...e chief. However, I suppose it was the best thing that could have been done under the circumstances. Had he not arrived when he did, there can be no question that the Free State Boers would have come in and possessed themselves of all the land where the dry diggings now are, for, after the arrival of Mr. Campbell, an attempt was made to compel the diggers working at the smaller diggings down the Pniel side of the Vaal River to pay tribute to the Free State. An armed force did come into Pniel, and threatened to force diggers at Cawood's Hope, and such like places, to pay taxes to them, but the English diggers defied them, and the armed Boers seeing the attitude of the diggers thought it best not to attempt force.

I now propose to pass from the river diggings to the dry diggings. There had been, for some time before Mr. Campbell's arrival, talk about diamonds having been found at Du Toit's Pan, and Bultfontein—two farms, 24 miles from the Vaal, on the road to the Orange River Free State. The most wonderful portion of the Diamond Fields is that of the dry diggings. They derived this name from the fact that there was no water there, and the diamonds having been originally discovered in a light sandy soil, it was thought that they could be found without the diggers having to undergo the laborious operations of cradling and washing the soil before sorting, which they had been compelled to do whilst operating on the banks of the river. The first of of the dry diggings to attract public attention was Du Toit's Pan, to which a few diggers had resorted before the close of 1870. Small diamonds had been found on this farm, and on the adjoining one. Du Toit's Pan belonged to a Mr. Van Wyk, and Bultfontein to a Mr. Du Plooy. It is scarcely worth while to wade through the details of purchase and sale, and the disputes and actions at law, which came out of the purchase. It will be sufficient to state that these two farms ultimately became the property of the London and South African Exploration Company, and were, when first purchased by that company, under the jurisdiction of the Free State. The work here was found to be a good deal easier than it was down the river, no water being used. The big boulders which had to be dug out to get at the diamondiferous soil at Pniel and Klipdrift did not stand in the way of working here. The ground was all soft, and of a consistency which could easily be worked with a pick and shovel. There was no breaking up of the ground after it had been dug out. All the operation necessary to get it on the sorting table, was to sift it in a sieve with a large mesh in the first place, to get rid of the large stones, and afterwards to sift it in a fine sieve, which was usually made in the shape of a hand barrow, and swung to and fro by the men holding the handles, or fastened by reims at either end to upright posts, and worked just as is a swinging cot. The process of getting through the work was very light and simple. The early diggers on the dry diggings, dug pits of about two or three or four feet deep, threw the stuff into a coarse sieve, and then placed it on a sorting table, to get rid of the large stones, then took the coarse sifted gravel, and sifted it in a very fine sieve, where the sorter, with a piece of zinc, scraped it across the table, and picked out whatever diamonds

there were to be found in it. Reports of good finds continued to appear in the columns of newspapers which were then published at Pniel and Klipdrift, and as these reports increased in frequency, so did the population in bulk. Klipdrift had long before been abandoned as diggings. It was a town of shopkeepers and tradesmen, and was fed from the down-river diggings, such as Cawood's Hope, Forlorn Hope, Union Jacket, and other diggings of that sort. Pniel was in all its glory in the early part of 1871, when there was a rush off to Du Toit's Pan. The chief part of the time of the special magistrate at Klipdrift, during the first six months he was there, was taken up with the settlement of disputes about land which existed between the Transvaal Government and the native chiefs. The Free State magistrate had become a sort of king on his side of the river, and now, when the rush was taking place from all parts of the river to Du Toit's Pan, he took care to open a second court there; and, in a very short space of time, Du Toit's Pan became an immense camp. Very large and good diamonds were found there. The proprietors of Bultfontein did all in their power to prevent that estate being rushed, but they could not withstand the will of the diggers, who jumped the place. The proprietors appealed to the Government of the Free State, but the Free State Government had no more power than the proprietors themselves to restrain large bodies of men. The best thing that could be done was done to make terms with them. Mr. Van Wyk's friends, who first worked at Du Toit's Pan, gave him one-fourth of their finds for giving them the right to work there, but when the diggers came up from the river, they were not satisfied with this arrangement, and a monthly license to dig became the settled thing. At first, the cost of the license was 7s. 6d., but was afterwards increased to 10s. By the middle of 1871, Du Toit's Pan had become a town, with hotels, stores, and shops; and then, it having been noised abroad that diamonds could be had for the picking in the South African Diamond Fields, the excitement was no longer confined to South Africa—men came from England, America, and Australia. The roads from Cape Town and Port Elizabeth to the diamond fields were full of life—vehicles of all sorts ran between the fields and the colony. A rude kind of omnibus, drawn by mules, was the first attempt made to convey passengers to and fro. For some time in 1870 and 1871 this and the post-cart were the only public vehicles by which the fields could be reached. Afterwards, transport companies sprung up, and the journey of from six to seven hundred miles was made in about eight days, and with a fair amount of comfort.

The adjoining estate to Bultfontein and Du Toit's Pan, Vooruitzigt, was the property of Mr. de Beer. He and his sons had been working Vooruitzigt as a farm, but they, seeing the success of the Du Toit's Pan and Bultfontein diggers, and that their farm partook of the same character, commenced digging at old De Beers for diamonds also. They found a few; this brought other diggers to the spot, and then they resolved to open diggings, which they did on the same terms as their neighbours at Du Toit's Pan and Bultfontein. They laid out a town and offered erven, or sites for building, at auction, on the 21st of October of that year. Nearly up to the time when these diggings w there had been great suffering fro water. One gentleman, residing at the Pan" hotel, after being there for without being able to get water enoug determined to have a bath of soda ordered the landlord to send him as m sodas as would be sufficient. This refused to do, as he had got the sod difficulty, in order to sell it with brandy t "Then," said the customer, who want "send me the brandy with the sodas, have my soda's and b's." This the lan the gentleman told his friends that l brandy and bathed in the soda water.

At old De Beers, water was foun lesser depth than at Du Toit's Pan, an to the picturesque appearance of the it the most attractive, especially to had brought their families with the De Beer's afterwards became the Bel Fields; it was the residence of the Lie during the time the fields were rea as they should be; and, of course, the the Lieut.-Governor was, as it oug centre, around which society gather and plumed its wings.

In July, 1871, came the crow diamond discoveries in South Africa. month of that July a new rush had b at about a mile beyond De Beers, an monds were found near the surface. small "kopje," or hill, a few acres rounded by a reef of hard rock. Th marked out by a gentleman, Mr. Fi residing in London, and all taken ou monthly license system. There was a diggers' committees, strictly adhered and afterwards, when the Fields had l British, was as rigidly adhered to by ment, viz., that no man should hol a certain number of claims; tw claims were first allotted, and, I afterwards by purchase or otherw not sure of the number, but tha the limit, and no matter how a man purchased, he could not r than the fixed number in his own claims given out at the Colesberg thought, at about two months after of the kopje was commenced, to be thing in the world for those to were given. Fine large stones out in abundance, and within t after the claims had been marke were sub-divided, and quarter cla as much as £500 and £600; whol fetch, in some cases, as high as the prudent people who saw this, re utterly reckless men were when in sea The De Beers were prudent men. Alfred Ebden, of the firm of Dunell Co., merchants, of Port Elizabeth, c visit to the Diamond Fields, and of Beers £6,000 for the Vooruitzigt e included the Colesberg Kopje and diggings, and town, with a vast homestead, and other building besides, at it, pocketed the money, and thoug very fortunate indeed. Before diamon

, I have no doubt they would have taken Mr. Ebden formed a company to work the tzigt estate as diamond fields, and the s to that company were magnificent.

Wherever there were diggings, a town of course g up round them. As it was at Pniel and Klip- so it was at Du Toit's Pan and Vooruitzigt. t all the diggings. The last discovered ngs were, for years, known as the Colesberg , the town surrounding them as "The New ." The daily finds at this rush, immediately its being worked, were something marvellous, large fortunes were realised by some diggers, en July and the end of October. I just mber one illustration of the success which ded on the operations, of many. A Mr. , a Dutchman, bought half a claim for and in two months he had taken out diamonds value of from £15,000 to £20,000.

returns as these were frequently reported, e natural consequence was that the river s were abandoned for the dry diggings.

enry Barkly came to South Africa as High sioner and Governor of the Cape Colony al, as the successor of Sir Philip Wode- ieutenant-Governor Hay having filled the ppointment in the interval between the e of the one and the arrival of the other. y found that, whilst the Diamond Fields ng the Treasury, that they needed being n promptly and considerately. He, at the iest possible moment, came up to see the himself, to meet Waterboer, Pretorius, epresentatives of all interests. He was with a heartiness he has always been acknowledge. He had been gradually the machinery for governing the Fields thing like order; but the work was not the complications were great. His Excel- ne to the conclusion that the Diamond ould be annexed to the Cape Colony rned from Capetown; and whilst I, who d in the colony then some seventeen years, that such an arrangement would not was quite willing to fall in with it, for f having the Fields included in the British It must be remembered that at the time king of, the only Diamond Fields we had nand over were those on the Klipdrift e Vaal River. Pniel, and all the terri- een that and the Free State, was claimed ee State Government, and the Free State, son of a magistrate, was in possession of d all on that side of the water. I do not see what better course Sir H. Barkly e adopted than he did at that time. He ided the Cape Parliament, after his first nex the Diamond Fields, which they at is Excellency to suppose they would do . When next year came they declined. leaders of the Parliamentary majority n as far-seeing as was his Excellency, ld have listened to him then.

ggings went on yielding, but confusion, want of a settled Government, grew founded. Waterboer had always con- st the land on the Pniel side, on which were situated, was his. This the Orange e had consistently disputed. As I said was not "diamonds" which originated the dispute. The representatives of the Crown, recognising Waterboer as an ally having claims upon the British and Colonial Governments, had been desirous of putting him in possession, but the office of High Commissioner and Governor of the Cape Colony is not a light one, and the gentlemen who have so ably filled these offices during the last quarter of a century and more, had their hands too full of pressing work to be able to devote the time and attention they would like to have done to this matter of Waterboer's, or he would have been in possession on the day the diamonds were first discovered upon it. However, Sir Henry Barkly brought the matter to a point on the 23rd of October, 1871, by forwarding a document to the President of the Free State, and proclaiming, "Captain Waterboer and his people, British subjects, and the territory in which the dry diggings are situated, British territory." The proclamation made in the Diamond Fields was received with great rejoicings.

Previous to that time, a resident magistrate had been sitting at the New Rush, under British authority, and, strange to say, one had also been sitting under Free State authority at Pniel and Du Toit's Pan. The New Rush is situated between the two, in the same district, and there is but two miles distant between Du Toit's Pan and the New Rush. To get from Du Toit's Pan to Pniel, the Free State magistrate had to pass by the office of the rival functionary, the Britisher, and I know they frequently used to shake hands as they passed each other of a morning, and I have a notion that they as frequently spent a social evening together. The Orange Free State Government saw clearly that it could not control the enormous population which had now gathered round those diggings. The magistrate sent down found that the whole thing had grown beyond his control. When the proclamation was issued, and the British flag was hoisted, I am confident that President Brand and the Members of the Volksraad gave a sigh of relief—I do not mean a sigh between them, but one each, the President the biggest by far. Of course, there was a protest, sent to Sir Henry Barkly. A protest is a South African institution. Nothing is ever done to alter, or amend, or improve, or carry out anything whatever, but some one is sure to send in a protest against it. However, the protest at last brought the Orange Free State £90,000—what for I never understood yet, and I am sure that no one who reads the correspondence which passed between Sir Henry Barkly and President Brand ever will. I am sure Sir Henry Barkly does not. However, I may be allowed to say here, that I consider it worth all the money to have so good a neighbour as President Brand has proved himself to be, close to the Diamond Fields, only that I would prefer him as Lieut.-Governor of the State, to that of President of it.

The dry diggings at last attracted every one away from the Pniel diggings, and, for the most part, the diggers from the lower and minor diggings on the river. Klipdrift, as a town, held out until 1873, the residents all the time contending that the place they had settled, being the first permanent town built, was bound to be the seat of Government, no matter where the population was, or where the productive powers of the

province might be. The foundations of all the British institutions in the country were laid there—magistracies, the High or Supreme Court, and Land Commission, post-office, registry-office, and Government Surveyors' Department. Sir H. Barkly found the Cape Parliament fail him, when he endeavoured to annex the country after he had created the province and proclaimed it British territory, and he paid a second visit to the Fields about two years after.

Between the time of his first and second visit, the Government of the province had been administered by three Commissioners; but the divisions amongst the members of the Commission, and the irrepressible character of the diggers, had, before his Excellency's arrival, led to disaffection and complications; and he had seen, before leaving the Cape Colony, that some change must be made in the plan and principle of government. When he came he found the population so vast, and the magnitude of the enterprise so great, that he saw there was nothing left for him but to convert it into a Crown colony, and give the people a voice in the management of their own affairs. I can give you no better idea of the change which had taken place than to read you a sketch which I wrote at the time in a little work I myself published and dedicated to Sir H. Barkly, and which I have affixed as an appendix to this paper. (See A in appendix.)

Claims in the Du Toit's Pan diggings had been forsaken for what then appeared to be the more profitable claims in the Colesberg Kopje. At a banquet given to his Excellency at Kimberly, he said he had thought that the Fields might have been governed from Cape Town, and he had tried every means so to govern them. He found that they could not be governed from Cape Town, but must have a Legislative Council like that of Natal. He promised that he would bring this about. After this a Lieut.-Governor was appointed. Mr. Richard Southey, one of the most practical, skilful, and single-minded of all those able men who have served her Majesty in South Africa, being appointed to the office. A Legislative Council, under Letters Patent, was created, consisting of eight members—four nominated by the Crown, and four elected by the people, on a franchise that gave to nearly every one a vote, without distinction of race or colour. The Lieutenant-Governor arrived in 1873, and remained in office over three years. It will be easily imagined that it was not easy to govern so mixed a population, in which there were so many conflicting interests, and it will be as easily conceived that men, dissatisfied because they could not get all their own way, could, in conjunction with others bent on creating disturbance, soon breed disaffection. The Lieutenant-Governor was left to do the best he could, without the presence of soldiers or mounted police. An outbreak became inevitable: it took place, and a regiment of soldiers had to be sent up, under General Sir Arthur Cunningham, to show that the British authorities were not to be defied. I shall not enter into the merits of this outbreak, if merits there were. I merely state what were the facts.

During Mr. Southey's administration, the owners of Vooruitzigt, who purchased the estate for £6,000, had been taking from £20,000 to £25,000 per annum, for rents of sites for buildings a to be erected upon. The owners of t endeavoured to double the rents, an seen that it would not do to permit have such power over the town in w seat of Government was fixed, or th virtually become the Government. T Court had been removed from Barkly berley, and the whole machinery of g was centred there. I should have that, soon after Sir Henry Barkly ha British rule in the Diamond Fields, th Klipdrift had been changed to Bark expressed wish of the people there, and had been changed to Kimberley, in com the Secretary of State for the Colonies held the same office at the time, and th had the honour to represent in the I Council was named Hay, in honour of Lieu nor Hay, who was the first to assist in British rule to the Fields. Vooruitzigt chased by the local Government, with the of the Earl of Carnarvon, who was then Sec State for the Colonies, for £100,000, and t held sites of land under a month's rental, w upon to capitalise. This was done, and way the Government found itself in a po pay off the purchase money, and to have monthly license for Government purpo De Beers Mine is on the Vooruitzigt est was included in the purchase.

I must now travel back somewhat to understand how diamond mining in G West arrived at its present state of p What I am about to say will be understo apply more or less to all the mines, Du T and Bultfontein, as well as Kimberley Beers. It is years since those diamond could be characterised as diggings. The mines, and those who held claims in the K and De Beers Mines on monthly license the owners of the claims, these having c their claims as the standholders did thei The other mines belong to the London ploration Company, and claims on them on monthly license holdings—the com lately given their claimholders large adv return for increased monthly payments fo

Pniel and Klipdrift are no longer pla people go to seek for diamonds. All tha of the days of diamond digging at Pniel holes, from which men took out the diam a *debris* of gin cases, sardine boxes, a collars. Barkly is still a town, in which firms (one especially, Messrs. Hill and Pa doing a good business with the digger on finding diamonds of first quality on of the river, some 12 or 14 miles below and an interior trade is also carried on firm mentioned.

The process of diamond-seeking h through several phases. The original cla had their claims for the marking out, they were not called upon to inves They found diamonds in the light, loo soil, and having, for the most part, d when they got through that soil, sold who went on digging deeper, until t now to work low at from 300 to below the surface. When they found

thausted the soil in which they had the habit of finding diamonds, they came kind of loosely-packed rock, blue in colour, rd to crumble. They, at first, thought they ined, that the diamonds had all been taken d that there was nothing left to repay them rking, but on testing this new stratum, it und to contain more and a better quality of nds than the surface soil. Then capital be-necessary. The mines were gradually worked at a depth, for which the diamondiferous soil be no longer hauled out in ordinary buckets, at the top of the mine by manual labour, means of hauling-lines. Steam machinery be employed. After arriving at a certain the mines became flooded with water. The rley Mine was first flooded. The water had pumped out, which could only be done by the yment of powerful pumps worked by steam. t was discovered that there was reef in which were no diamonds, nothing but hard rock. ad to be taken out. For this purpose steam-had to be procured, and tramways made. required a great deal of capital, and those no capital were compelled to give way to who had. The general interests of the ders, in each diamond mine, are looked a Mining Board, elected for that purpose. cost of taking out reef and water is borne hole body of claimholders.

here a rough diagram, showing how the y Mine is laid out, and how it is assessed. l explain to you.

gram here shown is of the Kimberley Mine, plan upon which that mine is laid out. applies to all the mines. The Kimberley iptical in form, and its area is estimated t about seven acres. The squares you d out show the claims, and the figures the value of each claim for rating purposes.

25	claims	valued at	£7,000
80	,,	,,	6,000
43	,,	,,	5,000
29	,,	,,	4,500
32	,,	,,	4,000
48	,,	,,	3,500
35	,,	,,	3,200
14	,,	,,	3,000
13	,,	,,	2,500
11	,,	,,	2,000
8	,,	,,	1,000
1	,,	,,	600
2	,,	,,	500
1	,,	,,	400
2	,,	,,	300
2	,,	,,	250
1	,,	,,	200
14	,,	,,	100
19	,,	,,	50

essment is far below the selling price—rage 25 per cent. below. The £7,000 uld fetch £10,000 in the market, the out £8,000, and so on. This was the of last year. In about a month there ew valuation, and then it will be found alues will be much increased. The depth e averages from 300 to 400 feet. This early, if not altogether, worked by now, and so is the largest proportion of the other mines. For particulars, as to shares, premiums, and capital invested, you cannot do better than consult the admirably compiled share list of Messrs. Hurly and Gray, advertised weekly in London in the *South African* newspaper.

The claims of this mine, which might have been purchased for three-quarters of a million about four years since, could not, when that valuation was made in the month of August, 1880, have been purchased for 3½ millions of money.

For some years the Du Toit's Pan and Bultfontein Mines were almost entirely abandoned, and a large proportion of the claims in both might have been held on payment of rent and water rates, and the license money. Within the last two years the high price of claims in the Kimberley Mine drove diggers to go elsewhere. Old De Beers, Du Toit's Pan, and Bultfontein were still open. A certain portion in each of these mines has always been worked from the time digging was commenced in them. Since, however, they have been worked anew, it has been discovered that they are all rich in diamonds—indeed the largest diamond that has yet been found, that of Mr. Porter Rhodes, lately exhibited to her Majesty the Queen, was found in the, I believe, Du Toit's Pan Mine.*

The value of claims in the Du Toit's Pan and Bultfontein Mines, and, indeed, of Old De Beers too, have risen in a most extraordinary manner during the last two years. Many a claimholder has grown rich from the rise in the value of his claims alone. Since the proprietors of the Du Toit's Pan and Bultfontein Mines, and their claimholders have had their differences adjusted, the whole aspect of affairs in these two places has changed, and claims that, a few years since, were but of nominal value, are now most valuable, yielding almost as well as the Kimberley claims, and are held in very high esteem in the market.

It is estimated that there is invested in the diamond mines of Griqualand West some millions of money; and to give you an idea of the yield of diamonds, I may here mention that the value of diamonds sent through the Post-office alone in 1879 amounted to £3,685,000. The returns of last year's exportation are not yet to hand; they will certainly show a higher figure than that which I have quoted for 1879.

I have hitherto spoken only of the Diamond Fields in Griqualand West, but as the subject is the Diamond Fields of South Africa, it may reasonably be expected that I mention, however briefly, the Jaggersfontein diggings. These diggings are situated near the town of Fauresmith, in the Free State. Diamonds had been found, and diggings commenced there many years ago, but the operations of that time not proving profitable, they were abandoned. About three years ago, digging was renewed there, and with at first moderate success. Latterly, however, the yield has been excellent, and the diamonds of very fine quality, and the Jaggersfontein camp, in all respects, resembles those I have before mentioned at the same stage of their history. Claims, at Jaggersfontein, which two years ago could have been had for a nominal figure, cannot now be obtained for less than for £900 to £1,200.

* This I have discovered to be a mistake. It was found in the Kimberley Mine.—R. W. M.

I have as yet said nothing respecting the labour question. The working of claims, whether on the river, or in the dry diggings, involves the employment of a very large amount of manual labour, and the labour question has been one which has at times been very difficult indeed. The chief part of the pick and shovel labour is performed by natives, and when I tell you that during the last seven years 640,000 natives, who never worked for wages before, have been registered as servants to claimholders in the Diamond Fields, you will imagine how vast is the work of diamond digging in the Fields. Holding as I do that the best and surest way to civilise the natives, is to induce them to work steadily and to work for wages, I consider that the Diamond Fields have done more to civilise the native tribes fifty times over than all other efforts and institutions put together. The native earns whilst working in the diamond mines, 12s. per week in money on the average, in addition to his food, which may be calculated at 10s. per week, making his total weekly earnings 22s. The raw native, when he arrives first in the fields, has no idea how to use a spade or pick; he comes lean, naked, and stupid. That he is so, is no fault of his. Let anyone, who has watched the course of events in the Diamond Fields, speak fairly, and he will say that this native labour has been turned to good account, both for the native and his employer. You will see to-day in the Diamond Fields thousands of natives as well-dressed as the agricultural labourer of this country, and in a great many instances a very great deal better—they are better clothed and better fed. The natives here build churches and schools for themselves, and a very fair proportion of them have, after going back to their chiefs once or twice, settled down in the Fields, and have thrown off the yoke of the chiefs altogether.

Of course there are great thieves amongst them; the moral law had never been any law to them before they arrived in the Fields, and in the hands of bad men they are cunning and dangerous thieves. I do not wish you to understand from me that all the 640,000 natives who have worked for wages in the Diamond Fields have become model men—far from it. What I do maintain is that whilst they have all been taught to work, a very large proportion of them have been civilised to a very much greater extent than anyone could have calculated on, and that that civilising influence is still going on, and producing marvellous results.

I have told you in what way diamonds were first discovered in South Africa, how the diamond diggings were commenced, and how, in spite of difficulties and complications, they have been settled. Let us see, now, what the discovery has led to, and what value the Fields have been to South Africa and to this country, and of how much greater value they may still be if rightly dealt with. I should like to show, also, to the members of the Society of Arts, that Art has already advanced by their existence. We have now, in a portion of South Africa, 600 miles from the colonial sea-board, and in a part of the country that was before producing nothing, a producing power which gives about £4,000,000 per annum of raw material for the market. It has already made the fortunes of a great many people, given profitable labour to thousands of white men, and ta natives to work for wages. W large towns established round the m in which trade and commerce flouris extent, that two years since, when th were compiled, it was found that o million pounds per year was paid fo of goods to and from the ports. town has a municipality, the reve derived chiefly from a rate on housel amounts to over £25,000 per annu upon the Customs dues of the Ca Natal has been, that whilst the imp Natal in 1870, were £429,527, the £2,176,356 in 1879; that the import Cape Colony has increased £5,000,0 same period. I should state here, the mining operations of the Du To having increased so much, that th South African Exploration Company, of the mine, have been compelled to for a new town. To supply the town and its mine with water, a wa has been started with a capital and, I venture to say, that th this company will far exceed that water company in existence, and th and mines can afford to pay for brought from the Vaal River, a c miles, shows how great must be and the population. These Diamo employment for three banks. is about to be laid down betwee and the two provinces of the Cape much dependent upon the trade of Fields, that they are competing with the matter of routes for the trunk which is to connect the Diamond Fi Cape Colony. Those railways wou been made but for the wealth whic Fields have yielded. The railway means of opening up the coal fields on all sides, and of which Sir Bartl to you in his lecture. It has led to England of that branch of art wh nigh been exhausted—the diamond- It is useless any longer to say that only be cut in Holland. I saw yesterd well, at the lapidary works of Messrs Co., eighteen mills going, worked employed in cutting diamonds, and t there — all English workmen — has to be superior to that done on the would advise whoever is curious to monds are cut, or who wish to have for commercial purposes, to visit this This art of diamond cutting has est already in the Diamond Fields. N jewellers, who worked for bare wage masters there. The fields are giving in the English manufacturing district of workmen, and enriching the Bri turer. These are amongst the re wonderful discovery. I hope the c that government which Sir Henry B Provinces may not do it and the injury that I dread. The annexati land West to the Cape Colony is a bl

In the early part of my paper I reserve what I had to say on the s

questions, which have been the most disturb- :f all the questions which have been raised the Diamond Fields were first discovered. is "a Society for the encouragement of Arts, factures, and Commerce," and I regard there- this land question as one which should be ht under your especial notice. I have shown ow the development of the diamond mines d up to the advancement of art and commerce ly, and I want you to see how great a future in store for South Africa if she is fairly verned. I have shown you some measure has been accomplished through the open- of the Diamond Fields. I will now show left undone that ought to have been done. first place, seeing that Waterboer, and his before him, had been our allies, and that the were as loyal to British rule as if they had her Majesty's subjects, we ought to have ted the Boers from over-running his country, diately he complained to us, and we had ained that his complaint was well founded. neglected to do that, it was the more our to have taken over his territory promptly he asked us to do so, after the Diamond were open, and we saw that the Boers, both Free State and Transvaal side, were going possess themselves of it. You may not know, o, that it was seven whole years after we en over his country before we had settled ns of those who held titles to land in the made over to us, and that even Water- mself, who had made over the land to us, ed into a Court of law to obtain titles to farms. I cannot say whose fault this was. e it came of Imperial instructions. I only at it was not the fault of the Lieutenant- r of the province, and although I once that it was attributable to Sir Henry I am now assured that it was not the case. you that for some time after the special te arrived in Klipdrift, he was chiefly with the settlement of land disputes. I too that before that time the Transvaal a magistrate to Hebron, and claimed all try down from the Transvaal proper to s of the Vaal River. The Transvaal, how- eed to leave the borders of that territory to d by arbitration, Mr. Keate, the Lieutenant- r of Natal, being the final referee.

pray of you to give me your undivided whilst I explain how much depends upon er settlement of land and territory in Africa. Sir Bartle Frere, when in the l Fields, shortly before he left South or England, after expressing his amaze- the wondrous progress the Fields had d the vast wealth evidenced on all sides of s, said that if the diamonds should fail w—but there was no fear of that—these ould still prosper, for they are on the to the interior trade. Sir Bartle Frere t was quite true. The Diamond Fields are way to the interior trade of Africa, and if we ve the interior trade, we should hold it in hands as a precious gift not to be lightly of. But it is useless to tell us that the Fields are on the highway to the trade if you permit the way between the Fields and that trade to be blocked up against British enterprise. If other people are to have the gold and ivory, the ostrich feathers, karosses, &c., don't tantalise British subjects in South Africa by telling them that they are on the highway to the interior trade. Let me call your attention to a rough outline map. Lieutenant Governor Keate was called upon to decide whether this piece of country belonged to the Transvaal Boers or to the native. The two arbitrators who represented the disputants had differed, and, judging between them, Lieutenant-Governor Keate's decision was that it never was the property of the Boers, but that it was native territory. The Transvaal Government, notwithstanding this decision, persisted in keeping a Court open at Christiana, and the Boers continued to come into the territory and take land just when they pleased. I must say that Sir Henry Barkly took a firm stand on this matter, but he was never permitted to settle the country, although the paramount chief of the Butlapins had asked us to take over his territory and protect his people. That chief had made it clear to our Government at one time that his people would be sacrificed to Boer greed for land unless he received British protection. The promise was made to him that his country should be annexed to the British Empire, and he was comforted. That promise has not yet been kept, and we are now in imminent danger of losing much that we have gained by the grand Diamond Field enterprise, as well as that we had gained by the annexation of the Transvaal. This territory is left open for the off-scourings of native tribes to settle in, to live by plunder, and ultimately to get strong enough to make war upon the borders of either the Transvaal or Griqualand West.

Had the land of the Griqualand West territory been settled and occupied when the British flag was hoisted, the Diamond Fields would not have been altogether dependent upon the Transvaal and Free State Boer for the meat they ate, and all the cereals and vegetable stuff they required. Had that land been settled, and the Keate award put into effect, as it should have been, Colonel Warren would have had a lighter task in South Africa than he had when he was Land Commissioner of Griqualand West. Officials are reticent, but let him speak out, and I warrant you he could tell such a tale of meddle and muddle as is seldom to be found elsewhere. Colonel Warren had first to unravel the land complications of Griqualand West, and then he had to fight the natives, who had risen in rebellion because they were dissatisfied at the manner in which they had been treated in reference to that very land. Then he tried to settle the Keate award territory, but he was baffled and prevented, and it remains unsettled to this day. I am afraid to proceed further with this matter, but I desire that the members of the Society shall see how important it is for the encouragement of Arts, Manufactures, and Commerce, that the highway to the interior trade of South Africa shall be kept open from the West Coast to the East, and from East to West.

APPENDIX.

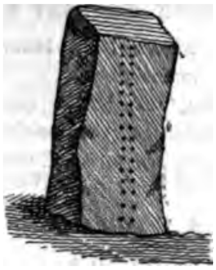
THE COLESBERG KOPJE.

Stand upon the brink of the Colesberg Kopje—that

great mine of wealth, one of the marvels of modern discoveries—and try to convey a picture of it to the mind's eye of those who have never crossed the Orange River. The task will not be an easy one; ten chances to one against your satisfying yourself that you have made others see what you see every day in the week, and are as familiar with as you are with the fingers of your own hands. But try, for all that; for there are tens of thousands of people who talk of the Colesberg Kopje every day, wonder what it is at all like, and wish they could only make out. Ask them if they have been to London. If they have, tell them to think of the London of the present day as they saw it last, or as they look upon it now, with all its palaces, theatres, churches, bridges, railways, tunnels, monuments, and statues, with St. Paul's, and its dome, and its golden cross included—aye, with all its streets, too, and its traffic, its broad and mighty Thames, rushing through the piers of the bridges that span it, and carrying ships and wherries on the face of its murky water. Tell them, when they have that picture well in their mind's eye, to imagine it all swallowed up by one sudden shock of an earthquake—sucked down into the earth as it now stands, and buried a hundred feet deep at least, and there left for ages, with all its palaces, gaudy-coloured shop fronts, its flaming column on Fish-street-hill, its river and its green parks. Think of what it would be like if, when after centuries of interment, the vast city, with all its inhabitants, had been turned into stone—one vast brown fossil, with none of the colours that now delight the eye; nothing but the forms left of everything;—that then sixteen thousand men should set to work in the centre of it all, excavating, as men have done at Nineveh, to reveal to another age the buried remnants of the past. That is to me what the Colesberg Kopje looks like. I know that there was no city buried there; but as I stand and look into the great cauldron below me, it needs no effort of fancy to trace out old cathedral doors and windows on these temples not made with hands, which are standing out in giant masses of rock from the surrounding excavations; bridges which might have spanned rivers; columns which one would think had borne the statues of heroes of a by-gone age; palaces that might have been sucked into the earth when Nature in convulsions set about making diamonds. There are, as I stand here, architectural patterns before me which it is difficult to believe are but chance lines that were made without one thinker to guide them. There is in one place as perfect a picture of the side of an old abbey, with its fantastical windows and carved doors, as if Westminster had been buried here, and had now been brought to light again. On an embankment that swarms with life, seventy feet below where I stand, are great masses of material, piled in blocks, lying in all fashions, some of them like broken rafters, halves of wheels, roofing and flooring. There are thousands of living beings climbing out of it and creeping about it. It bears a most perfect resemblance to a railway accident I once saw, and I have some difficulty in divesting my mind of the picture that had long ago passed away from my memory, and is only now again revived. A hundred fancies crowd into one's mind as one looks into and around the Kopje. It is impossible that it can be otherwise; it is so unlike anything else that one has seen, and it grows more and more wonderful every day. This time last year there were roads leading across the vast abyss, and connecting the sides and roads with each other. Carts and horses and men crossed and recrossed daily. Now the roads are gone; the stuff of which they were made has been reduced to fine sand, and men who then sometimes prayed for their daily bread, as if they knew they prayed in vain, worked for it with desperation, and for a long time almost in vain, are now living in luxury upon the proceeds of the precious stones picked out from the roadways. Not a road now intersects any portion of the Kopje; it is one great dock, that would take the whole of t dock and breakwater, and hide it away corners. It is but fanciful to picture the way; but, as far as the eye can see, it have written of it.

It needs a firm nerve to stand upon the l am now standing, and look through the ru the great network of ropes that cover th Kopje, as it were a spider's web spread ove and, in the midst of the great buzz, tc survey of the work going on. I have see tremble and clutch the staging whilst th this great human ant-hill. I have heard t felt bewildered; and no one could wonder The giddy heights, the noise, the bustle, are sufficient to bewilder anyone. If all the world had been driven into the Kopje, droning powers had been increased a milli noise could not have been more deafening. towers of Babel had been brought with hearing, the confusion of tongues could n There is here every type of man under He is the military man, who has dropped his the digger's cut, the navvy, the scholar, tl the man once about town, the young who once only rode the high horse, the yo man who never worked with anything he billiard cue before he came to this place, tl divine, the lawyer, the lamp-lighter. Hei thrown in together, all reduced to one leve alike with barrow, pickaxe, and crowbar. classifying them. For all that anyone can trary, they might all be nameless convicts number. When they heard of picking up Africa, they could never have dreamt of s this, or they would never have been here.

There is not a native tribe in Africa of w not hundreds of specimens at work in this l is the stalwart Mohow, sleek of skin and st some of them like giants, tearing away the and soil for their white masters; the ill-fc weedy Koranna; the intelligent Zulu, and tl Basuto. Of the twelve thousand at work, thousand natives, and of the ten thousand c from morning till night, and all the year r them, as naked as they were born. Tho dress most fantastically. Some are dig toiling at the wheel-barrows, which they ridges that a goat would scarcely care to work upon little ledges of rock, high up can help them. Some stand on the sumi sixty feet in height, and not broader than stride. Here they work with their c picks with as much unconcern as if they centre of a ten-acre field. You wonder h there, and wonder still more how they are down again. Whilst you look, one of then down to fetch something, possibly a bit of his pipe with, or a drink of water, or a hea than the one he has been working with. tool, sits on the edge of the narrow platfo he has been at work, puts his feet over th himself round, and lies for a second or toes just over the side, feeling for You can see little dark spots that dot the mass of rock upon which this man and h been working. This mass of rock was one roadway which has been removed, and it is of ten feet square, or thereabouts, standi high, with nothing to support it. It is d of this that the man is coming. The barl descending has no need to fear that he sh or spoil his clothes, for he has nothing in clothes upon him but a rag of about the siz fig-leaf, and an old felt hat with a feathe spots you see in the sides are foot-holds wh in pairs in this way:—



ving caught the two first holes, the man gradually lets himself down step by step, ble to grip the first two holes with his hands, comes down as easily as if he had a flight lescend, with a pair of banisters on each side ld on by. But if the rock, which is about nburnt brick, were to crumble away from otholds, or the edge of the platform were to en he lays holds of it to lift himself up to im, he must be dashed to pieces, for there save him. But it is with the diamond-s with the grave-digger,—

hath made it in him a property of easiness."

e men get to work in these awkward and ces by means of ladders, some rope-ladders, ordinary builder's ladder. Never has a th an accident in going to and from his s of the holes cut in the rock; but there ny accidents from climbing up rope and One that took place a few months since to show the kind of work these men have A resident of Cape Town had been a long unsuccessfully. Friends knew that he in Cape Town dependent on him for y saw that he was desponding, and at l him a claim to work on shares. He went It was a very deep claim indeed, and s reached by going down a ladder made rope, from the top to a ledge fifty feet ace. From that ledge there were ladders rent from ledge to ledge, until the bottom He had gone down safely, looked at the taken samples of it, and came up all lge upon which the rope-ladder rested. and feeling his nerves fail, lit his pipe few whiffs. He then proceeded to mount, as within fifteen feet of the top he felt lenly give way. He thought he could op, so he slid down again to the ledge, pe for a little while, and then made a . When within ten feet he became giddy. e was fixed to a chain, which he had to over hand; he felt he could climb no es utterly failed him, and he slid down the rope-ladder all right, but when he out ten feet of the ledge the rope-ladder d, and he fell with the piece of rope in was fearfully smashed, but he lived to

ad frightful falls without being much man fell over fifty feet, and came up ised. A man, aggravated by another, wn his claim, between forty and fifty e fellow came up again as lively as a as not even scratched. The greatest w apprehended is from the falling in of ral pieces have fallen in, and men have the ruins. It has been predicted that l yet fall in; and if that were to take ds of lives must be sacrificed. There ul slips since then, and many lives have of white and coloured men.

DISCUSSION.

Mr. James Price, in offering some remarks on the able paper which had been read to the meeting, would not attempt to criticise it, recognising as he did the amount of information contained in it. Mr. Murray had brought before the meeting details of the history of the South African Gold and Diamond Fields, which had not previously been made public, but which he had been able to give from his personal knowledge and experience. No doubt the Diamond Fields would have a very great effect upon the future of South Africa, and their existence would facilitate the creation of roads in the country, and would assist in opening up the interior to commerce. New fields were greatly required for our manufactures. One very important matter in connexion with the Diamond Fields was the employment of native labour. The natives were now taught to work, and native labour would in future be an important element in opening up the territory. They were now taught to wear clothes, which were sent as manufactured goods from this country; and, as the habits of labour and the requirement of clothing became more recognised, wider fields of commerce and for the consumption of English manufactured goods would be opened. Of the immense value of the Diamond Fields no doubt could be felt, seeing that the proceeds sent to this country amounted to £4,000,000. Probably many of those engaged in cutting the diamonds sent from Africa were present, and to them the paper would be specially interesting, as there had now been restored to this country a trade of which the Dutch had hitherto had almost the exclusive monopoly, and it was to be hoped it would become more and more developed.

Mr. Pfoundes questioned the pertinence of some allusions to Australia, which occurred in one or two paragraphs of the paper. He had been a resident in Australia for many years, and could testify, from his own experience, to the general high character of the Australian colonists.

Mr. Charles Fraser thought the paper presented so perfect a photograph of the parts of South Africa with which it dealt that it could hardly give rise to any discussion. It would be especially valuable to the industrial section of the community, as showing them what an excellent field for their labour South Africa presented. That remark would certainly apply to almost every colony in her Majesty's empire; and if the paper should be the means of inducing the agricultural population of this country to emigrate, it would be a benefit generally to the empire. Out of about 16,000,000 people in this country who laboured with their hands, at least 60 per cent. were idle for two months in the year, and assuming, for the sake of argument, that they earned about £2 a week all the year round, by the dearth of employment each man lost about £16 in the year, which sum, multiplied by 16,000,000, showed not only the aggregate loss to the working classes, but a loss of purchasing power which affected the entire manufacturing interests of the country. He would therefore say to the working classes of this country, "emigrate by all means." He, too, was an old colonist; and Mr. Murray would recognise in him one who stood beside him when the Diamond Fields were looked upon as a myth, and when the leading merchants in South Africa would not even advance £10 towards exploring them, so doubtful were they of any return to be obtained from them. If the paper should have the result of inducing working men to go out to that country, it would have achieved a worthy object, and one which he believed Mr. Murray had very much at heart.

The Chairman entirely agreed that the paper showed a high degree of thoughtfulness, and that it could not but be attended with a good result. Mr. Murray had told, in the plainest and clearest way, the history of that wonderful province, which though one of the smallest and most

recent, was certainly one of the most remarkable among the dependencies of the British Crown. Scarcely anything in books of imagination, or even in the "Arabian Nights," was more wonderful than the story that had been narrated in the paper. That a tract of veritable wilderness should become more valuable and wealthy than the most valuable centres of the wealthiest capitals in the civilised world, was a fact that seemed hardly credible, but these Diamond Fields, in a remote desert, had, in truth, become more valuable than any land in the centres of civilisation. Another interesting fact disclosed by the reader of the paper was the connection established between the highest civilisation and the depths of barbarism, for they found that, by an extraordinary chain of circumstances, high art, science, and even luxury, were contributing in a remarkable way to elevate the natives, and to ameliorate their condition. Those who, in the great cities of Europe, India, and America, spend their surplus wealth in the purchase of diamonds, contributed, perhaps little knowing it, to the improvement, in a wonderful degree, of the natives of South Africa. Missionaries, good men as they were known to be, must, after all, teach the native that his condition can only be improved by labour. The civilising influences in all countries were really the spade and plough, and colonists who taught the natives to labour, were as true pioneers of civilisation as any other class of men. In that respect, therefore, the colonists of Griqualand West, who were employing native diggers were rendering yeomen's service to the cause of civilisation. A very fair remark, he considered, had been made by the gentleman who spoke on behalf of the Australian colonies, but he did not suppose for one moment that Mr. Murray intended to throw any shadow of reproach upon them. It was of the highest possible consequence that the colonists of every colony of the empire should endeavour to work amicably and conjointly together, because after all, the empire depended to a great extent upon its colonies, and the day was not far distant when those colonies must be brought into closer contact with each other, and with the mother country. That result could only be brought about at an earlier date, as contrasted with some distant period, by their striving together in a common work. It only remained to propose a hearty vote of thanks to the author for his paper.

The resolution was carried unanimously.

Mr. Murray, in acknowledging the vote of thanks, said that he had no more intention of reflecting upon Australia than upon California, or upon South Africa itself. All he wished to point out was the comparative amount of crime in the colonies, not committed by the colonists themselves, but, as in the case of California, by the waifs and outcasts which had drifted there from all parts of America. As he had told them, though there were but few ports in South Africa, they received some outcasts from society as well as America. He had certainly no intention of reflecting upon Australia, which he himself held to be one of the gems and great glories of the empire. He was greatly obliged to the meeting for the attention they had given to his paper, which showed that they realised the importance of the subject brought before them. Whatever the character of the seed he had attempted to sow might be, it had been sown in good soil, and he was especially glad that so many of the industrial classes were present, for it was his great desire to assist labour as far as lay in his power. He felt that he had far from exhausted the subject or done it as much justice as it deserved, but he had done his best to present a plain narrative of the history of the South African Diamond Fields in the time allotted to him, without wearying the audience with dry details and statistics. At some future time he hoped to be able to fill up the gaps left in the paper.

FIFTEENTH ORDINARY MEE

Wednesday, March 16th, 1881; L

S. Churchill in the chair.

The following candidates were p

election as members of the Society:—

Adlam, James, 28, Aldebert-ter., Claphai

Beaumont, Colonel F., R.E., 3, Victoria-minster.

Browne, Harold C. Gore, M.A., 6, Lincoln's-inn, W.C.

D'Avigdor, E. Henry, B.A., Derwent Acton, W., and 15, Great George-street

Donaldson, J. Hunter, 176, Oxford-street

Greenhough, David William, 9, Mincing-

Henry, Ebenezer Walker, 27, Belsize-cre stead, N.W.

Maberley, Capt. Thomas Astley, 25, Parli S.W.

Mansfield, George, 104, New Bond-street,

Potts, Benjamin L. F., A.M.I.C.E., 174, grove, S.E.

Price, John Edward, F.S.A., 60, Albio Newington, N.

Welsh, Thomas Debell, 79, Arthur-road,]

The following candidates were ballo

duly elected members of the Society:-

Appleby, Herbert, Durnlea, Littleborougl

Attwood, George, F.G.S., F.C.S., 7, Regent's-park, N.W.

Hall, W. H., Weybridge-heath, Surrey.

Rattray, Netlam, 70, Gloucester-terrace, H

Richardson, Captain John Frederick, Houghton-house, Stoneygate, Leicester

The paper read was—

THE BEAUMONT COMPRESSED MOTIVE FOR TRAMWAYS, RAII

By Colonel F. Beaumont, R.]

From the earliest ages, the importa tating locomotion has been recogni civilising effect of interchange, wheth material, has been increasingly ap greater facilities have become availabl introduction of wheeled vehicles, the step forward was by macadamising ou enabling coaches to be run at speeds attainable. Three days was the ti London and the "Old Black Swan" testified by the placard over the l steam superseded coaches, the latter r to fourteen miles an hour. Rails before the introduction of steam upc the full value of reducing the rolling carriages to a minimum was never pr ciated by the public till steam rendere a possibility, and consequently ca tracks to be an absolute necessity. T tion of the iron rail became general found that not only would the cost reduced, but concurrently a speed possible quite unattainable with horse

After railways, tramways form the step in the progress of locomotion. the difference between a tramway an to be that the former is used for l while thus enabling cheaper works to be the tram-car shares the road with ot whereas the latter carries a high sp

ively its own. The conditions under which the systems have to be worked are dissimilar, and ir relative advantages and disadvantages may put down as follows :—

The railway commands all the movements on its ie, and can so choose its own rate of speed, nited only by considerations of safety. It has, the most expensive in first cost, certainly the ost perfect means of reducing to a minimum se working expenses of carrying a large quantity f traffic, while it enjoys the monopoly of high peeds. On the other hand, its cost is enormous, and the standing charges necessarily heavy. Its system is inelastic, and until a railway has actually made traffic for itself it cannot pay. It is usually computed that it takes seven years for an average line to create a remunerative business—or, in other words, a travelling public around it—sufficient to enable it fairly to rank as a paying concern.

In the case of a tramway—assuming the rolling resistance to be something not very far from a railway, and that a means is found of applying mechanical in place of animal power—how will comparison stand? It is cheap to construct, d it has no land to pay for. It must accommodate its traffic to that of the road, and, consently, can only move slowly. It is able, however, djust its working expenses, to a certain extent, he work it has to do; and it taps traffic and icts which a railway cannot touch. On the hand, it labours under the great disadvantage d gradients, and the obligation to divide its ge into small portions, thereby necessitating mallest, and consequently the most expensive, of engine. Notwithstanding these circumes, it appears to me that the tramway system t to become a formidable competitor to railfor a certain class of traffic, provided horsecan be superseded by mechanical power. A consideration will show that a tram engine t work under conditions enormously less rable than those of an ordinary locomotive. put this clearer—take the case of a fast train ing out of London—say, on one of our main lines. An engine drawing such a train l eed to do the work of 1,000 horses, and ing its journey, so far as gradients are coned, it will not be required to vary its power e than to a moderate extent. The engine will £3,000, which must be set against the cost of 0 horses at £40 each—say £40,000. Of course e figures are only used for the purpose of comon, and do not refer to the number of horses ired to continue doing the same amount of t. Now a tram-car is actually drawn by two s, value £80 (about 10 horses per car are ired for continuous working), for which it roposed to substitute an engine at a cost £700. Moreover, owing to gradients, the e will require to vary its force very largely, power has to be provided corresponding he maximum inclination, however small a ortion the incline may bear to the rest he road. A tram engine is, therefore, in a worse position than a railway locomotive owing economy as against horses, and this ective of other important considerations, s unusual wear and tear from its machinery close to a muddy road, or the shaking due to ng on an uneven track.

The great difference between a steam-engine for tramway and ordinary locomotive purposes, arises from the necessity which is thrown upon the tramway engineer to fulfil certain requirements which are not needed in the case of a locomotive. They will be readily understood from a perusal of the requirement of the Board of Trade, as laid down in the report of the House of Commons Committee on the application of mechanical power to tramways. The difficulties arise from the small space available, and the absolute necessity of avoiding the emission of smoke or steam, the machinery, too, requires to be completely covered; and certain mechanical controls are asked for on the tram engines, which are never used on ordinary locomotives.

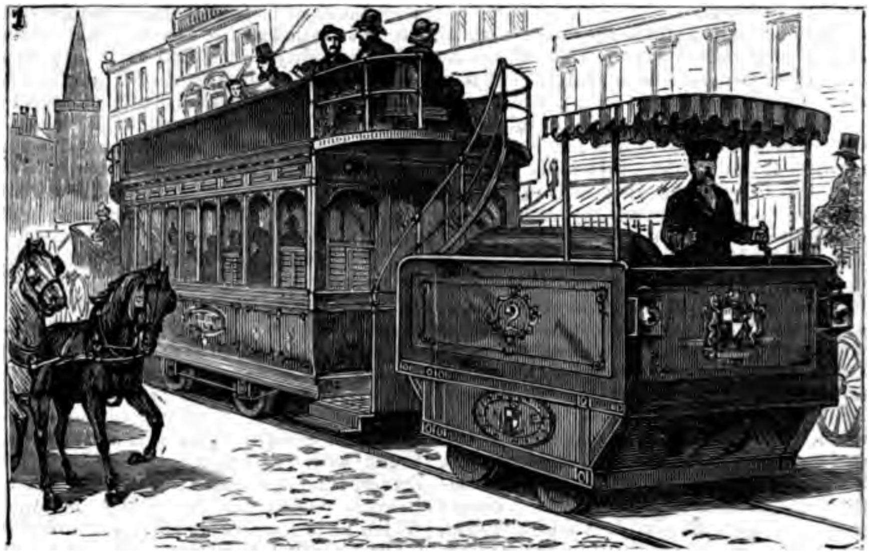
The difficulty in these connections will be recognised, when it is considered that a detached tramway engine weighs, say, seven tons, and stands on a small wheel base. Within this, a powerful engine and boiler has to be arranged, with the pumps, injectors, brakes, arrangements for condensing, and other details. To this is added an automatic brake, with regulator and speed indicator. The driver, therefore, has no inconsiderable number of handles within his reach, the manipulation of which he is responsible for. Moreover, these must be so arranged that they can be worked from either end of the engine. Any arrangement for condensing the steam, involves weight and complication, while the smoke can only be killed by a proper choice of fuel.

With reference to the second point, unfortunately, though smoke may be avoided by a proper choice of fuel, it is quite impossible to stop noxious fumes.

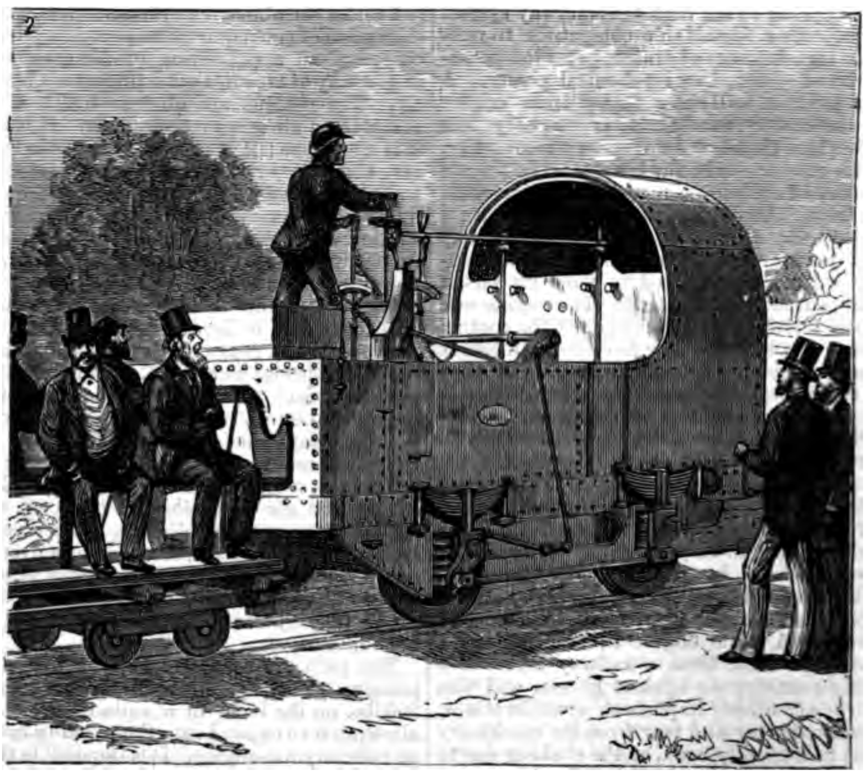
I make the above remarks, as it was from a consideration of the requirements necessary to meet the case, and an appreciation of the great difficulties in the way of steam, that I turned my attention to air. The reasons are obvious which recommend compressed air as a motive power. It is noiseless; it is smokeless; it is cleanly; it offends neither the ear, the eye, or the nose. A service of air-cars would be run in the following manner:—At intervals of every 10 miles compressing stations would be established, where the air would be compressed to the requisite amount by steam, or water power where available. These stations need not necessarily be on the tram line, as no loss worth noticing would be incurred by carrying the compressed air any reasonable distance, provided pipes of a suitable size were used. The charging would be done from a connection to be made between the engine and a tap, in a suitable box placed between the tramway lines beneath the road, of no more inconvenience to the public than a water hydrant.

There is nothing new in the proposal to apply compressed air to locomotive purposes, and when the advantages are so obvious, it is not remarkable that many efforts have been made to overcome the one weak point, viz., the difficulty of arranging so that a sufficient amount of power is available for practical purposes from the storage of a reasonable bulk of air.

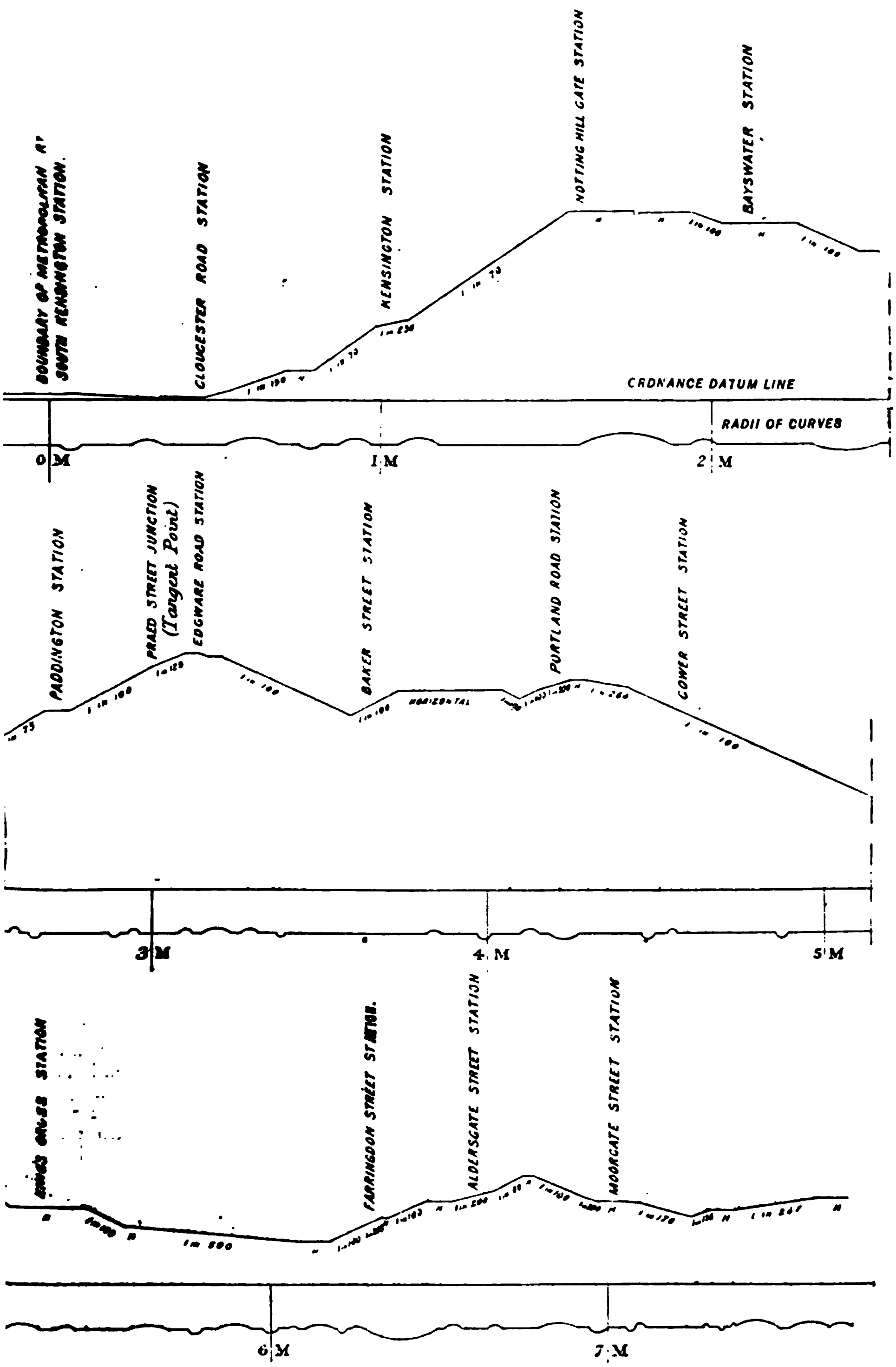
The earlier efforts were confined to simply compressing air at a comparatively low pressure, say 200 lbs. on the inch, in a suitable receptacle, and allowing it to expand into the working cylinders of an ordinary air-engine. It is impossible thus to get a satisfactory result, as a glance at the tables on



The Beaumont Compressed Air Engine.



Experimental Engine.



Section of Metropolitan Railway run over by the Beaumont Air Engine.

the wall will show the small quantity of power contained in a cubic foot of air at 200 lbs. Further, if no means are taken to supply heat, there will be a very serious loss of power from the cooling of the air during expansion, as will be explained further on; and, besides, the engine would soon be stopped, from the ice which would form in the ports of the cylinders, and block them.

More recently, far better results have been obtained, getting over the latter difficulty, by mixing steam with the air. This formed the subject of a very early patent, now expired. The machines, however, still use low pressure air in the cylinders, some form of reducing valve being employed to reduce the high reservoir pressure to the low pressure at which the air is admitted to the ordinary working cylinders of the engines.

These two specialities, viz., the mixing of air and steam together, and the use of a reducing valve, are both absent in my engine, which I will now briefly describe.

The engine is constructed so as to admit the full reservoir pressure, no matter how high it may be, direct to the working cylinders of the engine, without any wire-drawing, or, in other words, loss of pressure whatever; and arrangements are made by which the heat necessary to prevent the formation of ice, and to keep the temperature from falling during expansion, is supplied by externally steam-jacketting the cylinders.

A small generator is carried in a convenient corner within the framework of the engine, which supplies a sufficient amount of steam for the above purpose. The steam, which is condensed by the expanding air, runs back into the boiler; hence no pump is needed, and the grate area is so small as to be of absolutely no inconvenience; the whole apparatus is completely out of sight.

The engine is provided with variable expansion gear, which works distinct from the positive action given to the valves by the eccentrics. The expansion arrangement works so efficiently, that the air can be entirely shut off by its use; indeed, the driver controls the engine by the expansion, and not by the throttle valve.

The pressure I am working at is 1,000 lbs. on the square inch, and the sizes of the cylinders are so arranged that, even when the engine is working considerably above its normal power, there is cylinder capacity sufficient to allow the air to be reduced to the atmospheric line before it is discharged, thus ensuring the whole of the energy which is stored up in it being made available. The power of the engine remains practicably constant till the whole of the air in the reservoirs is exhausted down to the working pressure, thus rendering unnecessary any special reserve of air for mounting inclines. This is effected in the following way:—The power developed at any given reservoir pressure is in direct proportion to the quantity of air consumed; the use of the expansion valve, together with the power of admitting a sufficient amount of pressure direct from the reservoir into the big cylinders, enables the quantity of air consumed to be varied in proportion to the work required to be done.

There is, of course, no particular virtue in the pressure of 1,000 lbs., and it was arrived at by me in the following manner:—I found from inquiry amongst tramway authorities that, though there were many short lines, any system of mechar traction, to ensure its general adoption, shoul capable of running ten miles without refil To be on the safe side, I take the resistance to tion on a fair and level tramway at 25 lbs. pe assuming a gross load to be drawn of 12 tons engine, 7 tons, and car 5 tons. This will r

$$\frac{12 \times 25 \times 50,000}{33,000} = \text{say } 500 \text{ h.p., to be mag}$$

to go a distance of 10 miles.

Assuming that one-third of the total stored up in the air could be rendered av it will be seen that, with a reservoir capa 100 cubic feet, it is necessary to magazine t at 1,000 lbs. pressure, to be master o required amount of work, $\frac{100 \times 15}{3} = 5$

If 500 lbs. pressure is used, at least 200 cu of reservoir must be provided, and in either much larger amount will be needed, if a furt has to be incurred by wire-drawing fro higher to the lower pressure.

The engine stops and starts with the sa as an ordinary locomotive; the use of the pressure enables, in the high pressure porti the engine, very small cylinders and valves, slight travels to be used; hence I consid machine will be found peculiarly economical in of repairs. The cylinders and valves of the en already made have never required to be tou and there has hitherto—after extended trials— no sign at all of wear. The joints require making to stand 1,000 lbs. pressure, but once they can be relied upon. With any syst storing power by compressed air, it is abso essential, not that leakages should be reduce minimum, but that there should be actually By the courtesy of the Arsenal authorities, able to satisfy myself that this condition co relied upon. In the laboratory departmen Davidson is daily using air at from 1,000 l 1,500 lbs. pressure, and he has assured me t use gave him no more trouble than steam, no the arrangements necessary to be made were stood.

I will now summarise the results which been obtained in actual practice with my e and then offer a few remarks on the theo conditions involved in the use of compressed

The No. 1 engine, made by Messrs. Ma Wardle, and Co., of Leeds, was run for th four months in the grounds of the Royal A Woolwich, where in course of continual w drew a gross load of 22 tons—11 miles, and 1 —21 miles respectively, with one single ch 100 cubic feet of air. It subsequently m trip of some 16 miles on the South Eastern way, from Dartford to Woolwich and back. then run on the Metropolitan (Underground) way, and a section of the line passed over ha kindly furnished to me by Mr. Tomlinson, appended to this paper. The engine and ca together weighed about 20 tons, and over th with some fairly heavy curves and gradien duty done was three tons conveyed one mile, expenditure of one cubic foot of air, at 1,0 initial pressure.

The same engine, weighing ten tons, has a 42-ton Metropolitan engine, with its steam and on a very bad road, thus showing its po

At the works of Messrs. Adamson and Co., who are made the reservoirs I am now using, the engine was lifted off the ground and put under a dynamometer, and an actual result was obtained ... on 6 h.p. (for one minute), for each cubic foot air expended, from 1,000 lbs. This is about 33 per ... of the h.p. expended in the work of compression.

A No. 2 engine, specially made for tramway purposes, with a reservoir capacity of 60 cubic ..., will very shortly be at work, under a contract with the North Metropolitan Tramway Company, to work their Stratford, Leytonstone, and ... Forest line. It has been tried most successfully on the Leeds tramways, and also for shunting purposes at the Victoria Docks. I append a statement by Mr. Carr, the engineer to the Docks, of the work done. It will be noticed that the result shows ... tons moved one mile, for the expenditure of ... cubic foot of air:—

"January 27.—Air-compressed locomotive made for ... rail, weight about 7 tons, working on a piece ... straight level line in the Royal Albert Dock, back of ... 35 shed, 100 yards in length, drawing an open truck ... 5 tons laden with 11½ tons of brick rubbish. ... weight moved, including engine, 23½ tons (engine ..., truck 5, bricks 11½ = 23½ tons). The engine was ... at every journey of 100 yards. The pressure ... at starting was 925 lbs.

... pressure.		Minutes.		Lbs.
...5 lbs.	run 1,000 yards	in 9,	reduced pressure to	805
...5	,,	,, 9,	,,	730
...0	,,	,, 9,	,,	600
...0	,,	,, 13,	,,	505
...5	,,	,, 10,	,,	520

... yards run. Loss 405 lbs. in 50 min. 8 miles 73 yards per hour.

...ressure.		Minutes.		Lbs.
...	,,	,, 10,	,,	435
...	,,	,, 10,	,,	360
...	,,	,, 10,	,,	288
...	,,	,, 10,	,,	205

4,000 yards run. Loss 315 lbs.

... gross load of 23½ tons was taken a distance of ... miles, with a diminution of 720 lbs. from an ... pressure of 925 lbs. per square inch, in a reservoir ... capacity of 60 cubic feet. This is equivalent ... expenditure of 42 ft. of air at 1,000 initial pressure, which represents for the work above mentioned a ... (say) 3 tons conveyed one mile for each cubic ... air consumed. The line was straight and level, ... the other hand, 90 stops and starts had to be ... the distance run.—Robert Carr."

... results have been got with engines that are, ..., a little stiff, owing to their not being yet in ... work. From this cause, and by using certain ...ved arrangements for getting more heat into ... during expansion, I anticipate obtaining ... results than the above. Taking, however, ... as they stand, they mean that the expen... of from ¾ to 1 lb. of coal will take 3 tons ... on an ordinarily level railway, or develop ... for 1 minute under a dynamometer.

... compressing engines now erected at Strat... were indicated at Messrs. Adamson's Works, ... was from the results there obtained that the ... estimate is made of the coal required to pro... ... cubic foot of compressed air.

... use of compressed air, as ordinarily under... means only the reproduction of the power ... ed in the act of compression, whether steam ... be the agent employed. This, however, ... strictly true with reference to the latest form of engine, as heat is supplied to the air during expansion, thereby supplementing the store of energy received from the original source.

As mentioned earlier, the whole difficulty in connection with the use of compressed air arose from the loss of power involved in the way in which it has been hitherto used. The *rationale* of this is as follows:—Heat and power are exact mechanical equivalents, as shown by our talented countryman, Dr. Joule; or, to put it more plainly, any expenditure of power produces heat, a corresponding amount of cold being developed in the source of energy. This being so, the air, as it is compressed, receives the heat due to the mechanical energy employed in compressing it; and, in accordance with a well-known law, the pressure increases in proportion; as it is impracticable to keep the temperature of the reservoirs above that of the atmosphere, it is lost. When the air, in its turn, becomes the working fluid, the energy developed requires heat, which must be obtained (if no external source is available) from the air itself, the cold produced, or rather the heat abstracted, being in exact proportion to the power given off. It will be seen from this that, if arrangements are made to withdraw the heat of compression, and supply an equal amount during expansion, the power given off by the working engine will correspond with that absorbed by the compressors, the expansion and compression curves being on isothermal lines. It is to supply this heat that the cylinders of the engine are jacketted with steam; each unit of heat abstracted from the steam prevents a corresponding drop of temperature, and, consequently, of pressure in the working cylinder; in other words, it is turned into mechanical energy. At the commencement of my experiments, the doubtful point was whether a sufficient amount of heat could be got through the walls of the cylinders to materially affect the temperature of the air within. That my system effects this is shown by the air being exhausted at about 100° Fahr., when the engine is doing a normal amount of work, and by the reduction of steam pressure in the small generator, which takes place directly the locomotive is started, showing that the energy produced in the cylinders absorbs heat, which is abstracted through the metal of the cylinders from the steam surrounding them, a corresponding amount of which is condensed, and trickles back as warm water to the generator to be revaporated.

I have not yet had an opportunity of indicating the cylinders either for temperature or pressure, owing to the high pressure used necessitating special appliances, but I hope shortly to be able to do so, when a proper curve of expansion could be laid down. It will be noticed that any admixture of air and steam must be a source of loss if the same temperature could be got without it by external jacketting, as, in the former case, hot water would be discharged into the atmosphere. For the purpose of proving the correctness of my views, I introduced, as an experiment, steam into the second cylinder of my No. 1 engine. The pipe supplying it was furnished with a back valve, so that, while the air could not enter the steam pipe, the steam could mix freely with the expanding air, so soon as the pressure of the latter was below that of the former. Just as much steam was admitted as could be done without its showing at the exhaust. Comparative trials were made with the same engine, worked

under the two circumstances, at the works of Messrs. Manning, Wardle, and Co. (the makers of the engine, at Leeds), and it was found that no gain in effect was produced by mixing, whereas the convenience of the original arrangement was obvious; it was therefore finally adopted. The temperature thereby obtained is amply sufficient to keep the lubricating medium employed in a proper condition, and there is absolutely no difficulty at all in practice from this cause.

The Table below shows very clearly the importance of avoiding the loss which a reducing-valve entails, viz., a direct loss of no less than two-thirds of the whole energy stored up, if the air at 1,000 lbs. pressure is allowed to expand to ten times its bulk, *i.e.*, to 100 lbs. on the inch, before it is admitted to the working cylinder. This large loss would be still further increased in practice, as the average pressure at which the air would act on the piston would be considerably lessened by the throttle-valve. Where the value of the system depends altogether upon the amount of available energy which it is possible to store up, it is of the first importance to lose none of it.

TABLE.—Showing Amount of Power Stored, and Loss from the use of a Reducing Valve.

Pressure above the Atmosphere in lbs. per square inch.	Ratio of Expansion.	Hyp. Log.	Mean Pressure during the stroke.	Horse Power in 1 Cubic Foot of Air.	Horse Power in 1 Cubic Foot of Air at 1,000 lbs., when wire-drawn to	Per-centage of Loss from Wire-drawing from 1,000 lbs.
1,000	67·66	4,214,494	48·22	14·23	14·23	...
900	61·	4,110,720	46·66	12·41	13·75	3·5
800	54·33	3,995,073	44·92	10·67	13·27	6·8
700	47·66	3,864,090	42·96	8·93	12·67	11·0
600	41·	3,713,571	40·70	7·28	12·	15 0
500	34·33	3,536,017	38·04	5·69	11·31	22·6
400	27·66	3,319,984	34·79	4·19	10·24	28·1
300	21·	3,044,519	30·66	2·80	9·02	36·7
200	14·33	2,662,352	24·94	1·43	6·87	51·8
100	7·66	2,036,049	15·56	0·52	4·53	68·1

It appeared to me absolutely essential, before compressed air could come into practical use, that some construction of engine should be designed which would avoid the great loss which wire-drawing from high pressures would entail. The modern practical steam engineers recognise the desirability of this; and if it is necessary where steam is used, it is infinitely more so in the case of air where the fluid is more costly, and the loss from wire-drawing greater in proportion to the increased difference between the reservoir and boiler pressures respectively, and those in the cylinders.

The curve shown in the diagram expresses graphically the available power at different pressures dan the loss from wire-drawing. The difference between an engine working with or without complete expansion may be conveniently likened to the work done by a man on a treadmill, in the one case stepping directly on to the wheel from a high platform, and in the other, having mounted the platform, walking two-thirds of the way down again before putting *his weight on the wheel.*

I have before alluded to the re[...]
system has given, and the highest i[...]
fairly be claimed for them in specia[...]
for the working of underground rai[...]
ways, and to supersede the employ[...]
in mines. The entire average co[...]
English tramways is, approxima[...]
mile run, while the receipts are 16[...]
ence, 4d., representing the interes[...]
dividend on the capital employed.

The Company now working n[...]
willing to undertake the tracting [...]
6d. per tram mile, which correspond[...]
about 1d. per mile over horse tracti[...]
for two-horse cars, 7d. per tram mi[...]
will increase tramway dividends 25[...]
spective of releasing the capital rep[...]
horses now employed, which w[...]
Moreover, a change from horse to m[...]
tion is desirable, from a humanit[...]
view; the strain put on the tramwa[...]
severe, owing to the weight to be s[...]
inelastic character of the load, i[...]
and on inclined lines the condition[...]
often pitiable.

In mining, too, the horses and p[...]
have by no means happy lives, s[...]
with a heavy train of tubs behind[...]
step may cause them to fall in fron[...]
while the lights they are supposed t[...]
quently wanting; as they are so mu[...]
too, the tender mercies of their dri[...]
public control. Any system of [...]
would be an unmitigated blessing[...]
of the brute creation which is en[...]
ground.

The Channel tunnel scheme, now[...]
have actually commenced, is at[...]
public attention, and it is hardl[...]
statement to make, without air [...]
tunnel could neither be constructed[...]
able time, nor properly worked wh[...]

The most difficult problem in [...]
its construction is how to remove t[...]
small opening the *deblais*, and int[...]
and material necessary for the co[...]
work, the working faces being perh[...]
the entrance.

No system of traction by horses c[...]
its speed would be confined to three[...]
Ropes would be impossible, as the[...]
trains would be continually vary[...]
No amount of artificial ventilation[...]
steam locomotives to be used. The[...]
however, not only overcomes all t[...]
but it actually improves the ventila[...]
ing the permanent traffic, taking t[...]
of the train to be 200 tons, this w[...]
cubic feet of air per train mile, or s[...]
do the 20 miles between the Frenc[...]
coasts. A 60-ton engine could ca[...]
easily; there would, however, b[...]
difficulty in having an air mai[...]
charged, extending the length of t[...]
which, in the event of the neces[...]
engine could obtain the supply of [...]

As regards the Underground Ra[...]
recently made show the perfect [...]
working the traffic by compressed [...]
resolving itself entirely into one o[...]

king expenses cannot vary much one way other if air be substituted for steam, no heavy first outlay would have to be in- for plant. The public papers teem with stions and articles on the injurious effects th from the bad gases and defective ventila- the line. It rests with the public to judge r they will be willing, should it be neces- o pay a little more for their tickets and he luxury of fresh air. My own impression he cost to the railway would be more than balanced by the gain, but at the very out- sla (if loss it were) would be covered by increase in the fares. The science of power on a large scale is only in its infancy; mous field is opened, if only it is found ble, to manufacture energy at fixed centres, ing the power of locomotion ready for use. no doubt that compressed air has a very ture before it, and those who are first in the ll be the first to reap the benefits arising use.

DISCUSSION.

irman said they must feel indebted to Colonel for this new invention of his, which seemed in the future to occupy a very prominent It was no longer an hypothetical scheme, n practically tried at Woolwich, on the ern Railway, and on the Metropolitan a actual work; and it had since been tramway which was about to adopt it. to him that the main principle consisted eat in combination with the pressure of s they knew, simple compressed air had efore, but had never succeeded in any prac- Colonel Beaumont, however, appeared to the difficulty by jacketting the cylinders, eans he obtained greater elasticity in the reat saving in the use of it. This seemed but all great inventions were simple. He nter into the mechanical construction of which was not immediately before them, ntages appeared to be very great, especially of tramways. He did not think tramways to compete injuriously with railways, but be made very valuable as auxiliaries and em; and this invention was specially calcu- st that movement. In the country you often station which was two or three miles from the anted to go to, and if the railway companies mote tramways in such situations where it ay to make a regular railway, the amount hich would be developed would be very . There were many difficulties con- h the use of horse-power; horses re- ing, grooming, and stables; they got ill, nes died; whereas an air-engine was free se drawbacks. Once provided, all you had fill it with air by means of a steam-engine, l an engine of enormous power entirely under which you could convey a considerable load re miles with ease. The only question was the engine for compressing the air, which could, no doubt, in some cases, be effected f wind or water power.

has remarked that all who travelled by the d Railway would be grateful for the f the evils of smoke, noise, and bad ich they had to endure on that most a. Air was one of the elements given , and it was for human ingenuity to s for utilising it. Colonel Beaumont had practically shown how it might be used, and no doubt many ingenious men would soon be turning their attention to the improvement of this apparently simple but most useful apparatus. He would suggest that the heat required around the cylinder might be obtained by the use of liquid fuel—a subject which had been for some years before the Institute of Naval Architects, and thus the necessity for having a stoker would be avoided. This saving effected on the Under- ground Railway might go a good way towards the cost of providing the stationary engines for compressing the air.

Mr. G. Stevenson said that two of the Mekarski detached air-engines were placed on the Wantage tramway in July last, and continued to work the passenger traffic of the line between the town and the Great Western Railway Station at Wantage-road until the following October, the pumping station for sup- plying the engines with compressed air having previously been set upon a piece of ground in the tramway station-yard at the Wantage end of the line. The engines ran on ordinary days four journeys, each to and from the town to the station, and on market days and special occasions five journeys each, often taking two loaded cars up and down. No goods traffic was conveyed by them, but a trial was made on a portion of the line with a heavy truck-load of coals, which one of them moved with ease up a gradient of 1 in 44. The distance travelled over by each engine without a fresh charge of air was, as nearly as possible, five miles, and the quantity of air required for propulsion varied according to circumstances, but generally exhausted about 70 per cent. of the quantity stored in the engine and car for the service. The apparatus connected with each engine for carrying the supply of air for the journey consisted of four strong steel cylindrical vessels, three of which formed the battery, and one the reserve. The air at starting was compressed into these containers up to 30 atmospheres, or 650 lbs. to the inch. After the journey, the pressure generally ran down to about 5 at- mospheres in the battery, and 27 atmospheres in the reserve. The air, before passing into the cylinders, was expanded by being forced through hot water at a tem- perature of about 300° Fahr., which gave it additional moisture, and acted as a lubricant to the cylinders; the pressure at which the air was supplied to the cylinders varied according to the propelling power required, but seldom exceeded 70 lbs. to the inch. The speed at which the engines travelled on the line averaged about nine miles an hour, but from the pressure available, it was clear almost any reasonable speed could be easily attained by them. The smoothness and freedom from clatter, hissing, and noise of every description, was very great, and on no occasion did he observe the slightest appearance of vapour, steam or, smoke, either from the cylinders or the exhaust, and he was not aware of any horse having been frightened the whole time the engines were running. He was not able to ascertain the cost of producing the air for the propulsion of the cars per mile by the Mekarski air-engines, as the air-engine com- pany worked the traffic for three months at their own expense, but as far as he could learn, it took about 24 cwt. of coals per day to produce the power necessary for propelling the cars. He did not consider, in this respect, that anything like the best results of compressing the air were obtained, as the boiler used for the purpose of working the compressing engines appeared unsuitable, and swallowed up an extravagant quantity of fuel, and the whole apparatus was too ponderous for the small amount of work that had to be done. With the simple exception of the cost of working (which, at present, appears to be in excess of steam, although less than horse power), he knew of no motive power so free from imperfection, and so fully under control, as com- pressed air for tramway and railway lines, as well as for a great variety of other purposes, where a clean and noiseless motive power is required.

Mr. Francis Cobb asked what were the gradients on which the engine had worked, with a train behind it. Some of the gradients on the section of the Metropolitan line, as shown on the diagram, appeared to be as high as 35°.

Colonel Beaumont said the section was exaggerated. The steepest gradient he had worked on the Metropolitan Railway was 1 in 75. The steepest on the line, he believed, was near Snow-hill, where, for a short distance, it was 1 in 40; but the steepest he had taken the engine over was from Praed-street to Edgware-road, which was about 1 in 70 or 75. The steepest tramway gradient he had worked was 1 in 13 at Leeds, in Cooperage-street. There was nothing in the use of compressed air which assisted an engine to mount a gradient, or the reverse, as compared with steam. Steam or air could only supply the motive powers to the wheels, and if the wheels refused to grip, the engine and its load must remain at the bottom of the hill. But there was one point in which it seemed to him that compressed air had a great advantage. If you had a detached engine, and it had to work up steep gradients, such as 1 in 15, or 1 in 18, similar to those which often occurred in tramways, as in the case of the North Staffordshire, you could not get an engine to mount such an incline with a reasonable load behind it, unless it had a weight of about 13 tons, which meant that that weight had to be dragged over the whole line in order to get over the difficulty of that single gradient. Now this difficulty was removed if you could combine the engine and the car. The difficulty of doing this in the case of steam was very great, but with compressed air there was no difficulty whatever, as the reservoirs could be carried on the top of the car, or under the seats. The remarks just made on the Wantage tramways had a very important significance, because they showed that instead of compressed air being ridiculed as a motive power, as was the case a few years ago, it was creeping into public favour, and there was a growing opinion that it was one of the coming powers of the future. The result of the trial made at Wantage, and it was only a trial, showed that compressed air answered all the purposes required of it, and that was an enormous step forward. The only objection was, that Mekarski gave no satisfactory information as to the cost. Now, it was exactly on that point, having seen what the Mekarski engine did in Paris and elsewhere, that he took up the question; and he saw that compressed air could only be used advantageously by avoiding the enormous loss shown in the diagram to arise from reducing the pressure, and supplying the necessary amount of heat by steam-jacketting the cylinder, which were really the alpha and omega of his improvements in the application of compressed air.

Mr. C. B. King said it was not quite correct to state, with regard to the North Staffordshire tramways, that it required an engine weighing 13 tons to get up the incline. It was done with a steam locomotive weighing only 9 tons.*

Colonel Beaumont said his information was derived from the experience of Messrs. Manning and Wardle, who put on an engine which, he believed, weighed 12 tons empty; at any rate, he was within the mark in saying 10 tons empty, and he contended that that was far too heavy a weight to put on any tramway line.

Mr. Bodmer said the theoretical advantages of Colonel Beaumont's system, over those in which reducing valves were used, must be conceded, but the difficulty which at once occurred to an engineer was, how, with such high pressures, were leakages to be avoided, and he should like to have this explained.

Mr. Haughton congratulated Colonel Beaumont on the way in which he had compressed his paper, whilst complimenting him on its construction, must he should have liked to hear a little more about construction of the engine. He should like to how this enormous pressure was dealt with, and whether there would be any difficulty in dealing still greater pressures. If these enormous pre could be satisfactorily utilised in every-day wor should gain advantages we had never hitherto en for if air could be compressed to a pressure of 2,000 lbs. to the square inch, or even perhaps there would be an enormous gain of power. peculiarity of this engine seemed to be the intro of air at an enormous pressure, and the co cation by external means the heat necess enable it to expand, thus utilising the power co within it. If the engine worked satisfactorily, seemed to have done so, and would continue satisfactorily, there was a very great future be for it was evident that certain railways could worked by this or one or two other means. Th instance, the Channel tunnel: they had all had p experience of the defects of ventilation on the U ground Railway, and it was therefore obvious that, a tunnel 22 miles in length, the atmosphere wil absolutely pestilential from the products of comb if steam were used. For the tunnel to be a succ must be worked either by the pneumatic system— of wind behind the train, or by some compres system, or, lastly, by an electric railway, such now about being tried in New York. He sh glad to know whether these high pressures c indefinitely utilised, and, further, what was the amount of duty per lb. of coal obtained during of compressed air.

Mr. Perrett, whilst wishing Colonel Beaumon success, feared that his views as to the applic his system to tramways were rather too sanguin had stated the traction at 25 lbs. to the ton, a might be so where the tramway was new and go the road clean, but from some practical experie know that 45 lbs. to 50 lbs. would be nearer th as an average, and, therefore, half the power w at once. His calculations referred to a practical line; and it would be the same thing where the g did not exceed 1 in 100 or 1 in 80, because wh lost in going up hill would be gained in going but with anything beyond that you required an e power in going up, and to put on the breaks going On the majority of level tramways, the compani satisfied with horses, but they wanted mec power to work them up over steep places; but f places, it seemed to him that compressed air wa factory. He had in his mind two towns, one of had an average gradient of 1 in 34, rising in som to 1 in 17, for 4,000 yards. In that place th very anxious to have some mechanical power, horses could do the work, he, though an enginee confess he should prefer them to any mec arrangement, if it could be done for the same To his mind, it depended far more on the si of the engine and on the absence of repairs t anything else. The cost of repairs with ste enormous compared to any other item, even fuel. If coals cost ¼d. or ½d. a mile, repairs cost 2d. and 2½d. In fact, the driver's wage to more than the coal. Again, the efficiency new engine seemed to depend on having a smal attached to it, but for his part he should much it if this could be dispensed with. Compres had many advantages, but it must be compare the steam-engine of the present day, not wit it was some years ago.

Colonel Beaumont, in reply, said that with re the question of leakage, any leakage in the r would be fatal, but they were able now to

* The gradients upon the North Staffordshire Tramway are *exceptionally heavy*, ranging from 1 in 12 (for 125 feet) to 1 in 88 (for 1,034 feet).

ibsolutely bottle tight, with no leakage what- No. 2 engine was pumped up when it was e Victoria Docks; about 300 lbs. pressure was about Christmas, and a sufficient amount of left in it to move the engine only a week to the provisions necessary to prevent leakage tons, he could not go into the details in such g, without drawings and diagrams, but the was similar to that employed by Perkins for pressure steam-engine. The leakage was by having a series of rings, which acted as the air, and made tbe piston all but tight. that it was not absolutly tight, it would be and that the second cylinder took up any leak- the first, and he did not believe—although it possible without indicator diagrams to say that that any serious loss from leakage occurred. and tear, the engine which was tried on the Railway remained, so far as its valves, and details, were concerned, precisely in the tion as it left the makers' yard about a year ago, ing done, not continuous work, because there the opportunity for that, but having run hundred miles, and required absolutely no all. He thought, in using these high pres- by wear and tear would be diminished rather sed. The engine must be powerful when it Metropolitan locomotive weighing 40 tons, was running 15 miles an hour the motion admitting the air was so small as to be eptible, and the valves by which the high was admitted were hardly as big as the top The force stored in the air at this high so great that it required a very small con- air. At the same time, while perfectly safe per precautions were taken, it was no doubt ithout proper precaution. To see that ere absolutely tight, he had a valve made d by means of an excentric in the builder's was kept running for two or three days, g off and admitting air. When the valve rork it was absolutely tight, so that you fety put your eye to it, and look up the e instant it was lifted the very least, the gh pressure coming out exerted so great a would not only tear a piece of paper ut if you put your hand underneath ear the flesh off your bones. Yet ength of time these valves had been ad not been able to detect the slightest r deficiency in the engine. One gentleman r further mechanical details, but, for the d given, it was impossible to go into that; say, that after the air had passed the high nders, there was no difference in principle ngine and an ordinary piece of machinery. een asked if it would be practicable to use sure of 1,500 or 2,000 lbs. on the inch. ent, that opened a new and most import- ich, by degrees, he was hoping to occupy. rn air to be compressed to 15,000 lbs. on nch; that was done by a gentleman at his object being to supersede the use of blasting in mines. He was turning his this direction; but finding this had been once abandoned it, as another gentleman the ground before him. He did not think, t the way in which it was being applied practicable, and he was now in communi- me people to see if some means could be hich the use of compressed air could be r dangerous explosives in mines. It was to compress air up to 15,000 lbs. to the en you came to use it again, no doubt a ficulties would arise. He would say, how- long a pressure of 1,000 lbs., instead of red anything enormous, would be looked upon as a reasonable pressure. For tramway and similar purposes, if you could go a distance of 10 miles with a single charge, there was no great object in going to a higher pressure, but in other cases it would be necessary. It had been suggested to him several times to make a compressed air tricycle, and he intended to try it. He thought it could be done, but, in dealing with these very high pressures, you had to deal with forces which a steam-engine had not to contend with, and con- sequently when he put the matter into a draftsman's hands, he brought out designs which were incom- patible with the light form which a tricycle must take. At the same time he believed it was possible to make a tricycle which should go three miles without recharg- ing, but the solution of the problem depended on the possibility of constructing an engine to work at a pressure of say 2,000 lbs., and which should lose no power by the use of a reducing valve. With re- gard to the amount of coal needed, the figures would be found in the paper, and that was an all important point with regard to the application of compressed air to tramways. The results of the trials already made were all summed up in the state- ment that one cubic foot of compressed air would take three tons one mile on a railway; and, with proper arrangements, $\frac{1}{4}$ lb. of coal would compress one cubic foot of air to 66 atmospheres. Consequently, $\frac{1}{4}$ lb. of coal consumed under the boilers of a properly constructed compressing engine would take one ton of mile, which about corresponded to the average duty a coal in a locomotive. It might be said, if that was the case, there would be an end of ordinary locomotives, but that did not follow, because a variety of other con- siderations came in, especially the extra cost of plant. The Underground Railway could probably be run at about the same working cost, but it would require an increase of 50 per cent. in the value of the plant, and the bulk of the present plant would be rendered useless. Mr. Perrett said he would sooner see the work of tramways done by horses than engines, but in winter, and bad weather especially, the horses had a very hard time of it, and, therefore, he should have rather expected an engineer to say that he would prefer to see the horses doing some other kind of work. But that point did not really concern an engineer; because he was quite certain that no system of mechanical traction had any chance of superseding horse-power unless it showed a saving. In that view the offer he was prepared to make was to take any tram line and tract it at 6d. per mile, instead of 7d., which represented the average cost of horse traction, as would be seen by an examination of the accounts of the North Metropolitan Tramway Com- pany. That would show a saving of 1d. a mile, which would add 25 per cent. to the profits. The same gentleman seemed to think there was a diffi- culty about a compressed air-engine mounting steep gradients, and, if that were the case, any engineer would be a lunatic to think of introducing it; but the fact was, of all lines he should prefer to work with compressed air, would be one with a steep gradient; because the cost of horse flesh in- creased in proportion to the gradient, and so did the difficulty of working with a steam locomotive; simply because the boiler was tipped up at an angle, and, consequently, laid bare the tubes. They all knew the danger and difficulty which attended any portion of the tubes of a locomotive getting burned, because the cost of it depend principally on keeping the boiler in repair. This was so important that, in some cases, where steep gradients had to be encountered, a vertical boiler was used, but that was always an unsatisfactory arrangement. Another difficulty was that it was quite impossible for a steam locomotive to proportion its weight to the work it had to do. The boiler had to be capable of supplying the cylinders with steam, in pro- portion to whatever the maximum draw might be, and the maximum draw depended on the maximum incline

the engine had to ascend. With compressed air this difficulty did not arise. You could run up an incline of 1 in 14, with a comparatively small supply of air in the reservoir, because you could take in a fresh supply either at the bottom or the top of the incline. Consequently, if you were working a tramway line, where the incline for a short distance was very severe, it would need no special arrangement beyond a provision at the bottom of the incline for giving the engine a fresh supply of air.

The **Chairman** then proposed a vote of thanks to Colonel Beaumont for his interesting paper, which was carried unanimously.

MISCELLANEOUS.

A NEW TELEPHONE.

A paper "On the Conversion of Radiant Energy into Sonorous Vibrations," was read before the Royal Society last week, by Mr. W. H. Preece, the electrician to the Post-office. The remarkable discovery of Messrs. Graham Bell and Sumner Tainter that the rapid intermittent incidence of rays of light on discs of hard substances produces sonorous vibrations has attracted very much attention, and has excited much physical work to solve an unexpected problem. The advocates of the emission theory of light have striven for 200 years to obtain such a proof of their theory and have failed. Why have Bell and Tainter succeeded, or have they succeeded at all? May not their phenomena be due to some other cause than to the incidence of light? It was suspected by many that it was a heat effect, and not a light one at all. M. Mercadier, in Paris (Comptes Rendus, Dec. 6th, 1880), and Professor Tyndall (Proc. R.S., Jan. 3rd, 1881) have placed this beyond the region of doubt, and now Mr. Preece has completed the chain of evidence by a careful and elaborate inquiry into the cause of the phenomena. In the first part of his paper he has shown that ebonite and india-rubber, though opaque to the light rays, are remarkably diathermanous or transparent to the heat rays, and therefore that radiant heat can act through screens of those materials. Indeed, ebonite is shown to be almost perfectly transparent to radiant heat, while it is absolutely impervious to light. He next shows by experiments made on very delicate apparatus that no more vibrations than six per second can possibly be produced by the direct impact of heat waves causing expansion of the mass of the disc, and therefore that the Bell-Tainter effect is not due to the absorption of heat changing the volume of the hard substance experimented upon. He next inquires whether the effect observed is due to a molecular pressure similar to that which produces the rotation of the radiometer, for this being a mere surface action, the element of time is eliminated. Many experiments are described which were made with discs of various kinds in different ways, but the results were so unsatisfactory and variable that the question was raised whether the discs vibrated at all. By the aid of microphones and specially constructed chambers, it is proved clearly that the undulations are those of the contained air, and not of the discs. In fact, the sounds were intensified by removing the discs. Moreover, the effects were materially assisted by coating the sides of the containing vessel with a substance highly absorbent of heat, such as the carbon deposited by burning camphor. It is next shown that the effects are dependent on the number of heat rays that pass through the discs, and not on those that are incident on them, and that the greater the absorbent character of the air or vapour contained in the case, the more intense the sounds emitted. All these results are repeated and shown with ordinary flasks lampblacked on their exterior and interior. Finally it is shown tha a time element introduced, and that the loudn note emitted depends not only on the rapid which the contained air absorbs the radiant but also on the rapidity with which it giv heat to the sides of the case and the exit it. It varies also with the form of the space, and with the character of the vapour, and with the diathermancy only of The effect being thus due to radiant heat absorption by suitable surfaces, it was next sl if a spiral of wire be completely enclosed in blacked case, sounds were emitted when cu electricity were rapidly and intermittently tr through the wire, and, moreover, that wl currents were produced by a proper microph mitter, articulate speech was reproduced. H phenomena are simply effects of radiant heat, are due to the changes of volume in absorbent vapours, produced by the absorption of the heat in a confined space. All the varied experiments which Mr. Graham Bell perform he was recently in Europe with solids, liq gases, with tubes, flasks, and discs, are thu within one simple explanation, and are due to able influence of degraded heat rays on vapours. The final result of this inquiry has only to unravel an exceedingly interesting problem, but to produce another form of t based on a new principle.—*The Times*.

LUMINOUS PAINT.

The manufacture of this paint, which brought prominently into public notice by M paper upon it last year (*Journal of the Soci* vol. xxviii., p. 389), is stated to be progres factorily, the manufacturers having succeed siderably reducing the cost of production, quently the cost at which the article can b cially supplied. One of the more importan applications of this material is for the white- ceilings. When the paint was first made, i posed to utilise it in this manner, but one d doing so was the high cost of the material second was that it could only be applied with and not in the ordinary manner of a lime was seems, however, now to be no difficulty application, and several small rooms h successfully treated. Mr. Spottiswoode, t dent of the Royal Society, has had th of some rooms in his house covered with t and at the company's offices in Aldermanbu also a room with a luminous ceiling. Th better than might have been anticipated. appears as if it were lighted with bright moo cept that no portion of it is brighter than as is, of course, with moonlight, where the r moon actually fall. Even on coming into s out of the daylight there is no difficulty sufficiently well to walk about the room, tak objects from the table, &c., and after a few m eyes become sufficiently accustomed to the l able, at all events, to see the time by a watch face. Another novel application is t lanterns, if such an expression can be used. formed of oblong tin cases, the outside of t coated with the paint. Upon hot water bei into the inside, the luminosity of the paint is a very high degree. It is well known to have experimented with the material that on surface covered with it by magnesium wi powerful illuminator, the great brilliance wh diately results dies down in a very short time, comparatively dimly-lighted surface. The l water brings out the same amount of brill

naximum as long as the water remains , little water be placed at the bottom of ninosity may be aroused by shaking the rarm all sides of it. As it dies down rings it up again. This form appears in the ordinary plan of having a sheet of d with a glass and set in a frame like that These appear to be the principal applica-ose noticed in Mr. Heaton's paper above The paint is also used to a considerable ing match-boxes, statues, brackets, &c., s as these can only be included in the ting scientific toys.

ORRESPONDENCE.

ITISH RULE IN INDIA.

an opportunity of being present at Mr. resting lecture on "The Results of India," I trust you will allow me to arks on one branch of his subject, which require further investigation—the ques-her there is, or is not, danger in the r-population in India.

lace, Mr. Maclean compares the num-ilation per square mile in India with the other countries, and shows that, whereas to the square mile, Belgium has 451; 'ales, 389; Tuscany, 377; the Nether-ina, 289; Great Britain and Ireland, erg, 249; and Germany, 193. This is, ful comparison as far as it goes, but it urther than the edge of the subject. To rould suggest to Mr. Maclean that it mportant to give your readers the fol-ion as regards each country:—

ation in each country depending on subsistence.

nt of the agricultural condition and ing especially whether the people have, means of maintaining the fertility of

t of the probable rate of increase of the

e of the culturable unoccupied lands.

ter of the population, and whether it is g tendency.

r necessary further investigation is, I at, as regards the first point, I once had writing on the danger of over-popula-India with Belgium. I then found tural population of India exceeds that ile, taking into consideration the vast idia, I found the agricultural population square mile so much exceeding twice the pulation of Belgium, that it certainly o be quite safe to say that the agri-ion of India is, to the available square uble that of Belgium. In other words, m, from the bare statements of statistics, have twice the pressure of population the latter country has practically a pres-uble that of Belgium; and I feel quite other points I have mentioned were ered, the danger of over-population in parably greater than would, at first be supposed.

lean has another test, though by his way would seem to be the only one needed. ontroversy," he says, "about over-population, resolves itself into the question—Are the rates of wages relatively higher or lower in proportion to the prices of food grain, than they were ten or twenty years ago?" Is not this, to say the least of it, a singular way of attempting to solve, or, I should perhaps rather say, shelve a most difficult problem? Let us, for the sake of argument, admit that the rates of wages in India are universally relatively higher in proportion to the prices of food grain than they were ten or twenty years ago, and let us ask what then? It is proverbially difficult to prove a negative, and Mr. Maclean has thrown upon himself the task of proving a most formidable negative. He must prove that the material increase of the population will not ultimately destroy his test; in other words, will not have the effect of again lowering the rate of wages relatively to the price of food, down to the rates which prevailed ten or twenty years ago.

Let me notice another of Mr. Maclean's conclusions. He thinks that because the Bengali refuses to emigrate, he must therefore be, "on the whole, tolerable well-satisfied with his lot." Are the Irish cotters, in the west of Ireland, tolerably well-satisfied with their lots, because they are disinclined to emigrate? I am afraid that this statement will no more bear examination than one to be met with some sentences further on, where Mr. Maclean informs us that the "English labourer, earning his twelve to eight shillings a week, is compelled to live on animal food and strong drink." I have no doubt that he only wishes he was put under any such compulsion, and that his wage were high enough to admit of his living so luxuriantly.

Robert H. Elliot.

Clifton-park, Kelso, N.B.

GENERAL NOTES.

International Wool Exhibition at the Crystal Palace.—In connection with this Exhibition, the Clothworkers' Company offer the Company's Gold Medal for the following subjects:—(1) For the best piece-dyed Navy blue cloth or worsted coating; (2) for the best Navy blue cloth or worsted coating, dyed without the use of indigo; (3) for the best scarlet cloth, dyed without the use of cochineal; (4) for the best 10-lb. sample of scarlet woollen yarn, used for shirtings, dyed without the use of cochineal; (5) for the best piece of bleached flannel, the bleaching to have been affected without the use of sulphuric acid in any form; also for various articles composed entirely of English wool (*i.e.*, wool grown in Great Britain and Ireland), and for the best apparatus for scouring and cleansing worsted coatings, previous to dyeing. Preference will be given to that which most thoroughly combines efficiency with simplicity and economy in working. The Drapers' Company have voted a sum for various special prizes, and other of the City Companies identified with the textile industries propose doing the same; these are in addition to the medals and certificates to be given by the Directors of the Crystal Palace Company.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at eight o'clock:—

March 23.—"The Increasing Number of Deaths from Explosions, with an Examination of the Causes." By Cornelius Walford, F.S.S. Professor Abel, F.R.S., will preside.

March 30.—"Recent Advances in Electric Lighting." By W. H. Preece., M.Inst.C.E. C. W. Siemens, F.R.S., will preside.

April 6.—"The Discrimination and Artistic Use of Precious Stones." By Professor A. H. Church, F.C.S. Sir Philip Cunliffe-Owen, K.C.M.G., C.B., C.I.E., will preside.

APRIL 27.—"Five Years' Experience of the Working of the Trade Marks' Registration Acts." By EDMUND JOHNSON.

Dates not yet fixed:—

"The Manufacture of Glass for Decorative Purposes." By H. J. POWELL (Whitefriars Glass Works).

"Buying and Selling; its Nature and its Tools." By Professor BONAMY PRICE, M.A. Lord ALFRED S. CHURCHILL will preside.

"The Electrical Railway, and the Transmission of Power by Electricity." By ALEXANDER SIEMENS.

FOREIGN AND COLONIAL SECTION.

Tuesday evenings, at eight o'clock:—

APRIL 5.—"Canada; the Old Colony and the New Dominion." By E. HEPPLE HALL.

MAY 10.—"Trade Relations between Great Britain and her Dependencies." By WILLIAM WESTGARTH.

APPLIED CHEMISTRY AND PHYSICS SECTION.

Thursday evenings, at eight o'clock:—

MARCH 24.—"The Future Development of Electrical Appliances." By Prof. JOHN PERRY. LATIMER CLARK, F.R.G.S., will preside.

MAY 12.—"Recent Progress in the Manufacture and Applications of Steel." By Professor A. K. HUNTINGTON.

INDIAN SECTION.

Friday evenings, at eight o'clock:—

MARCH 25.—"The Tenure and Cultivation of Land in India." By Sir GEORGE CAMPBELL, K.C.S.I., M.P. ANDREW CASSELS, Member of Council, will preside.

MAY 13.—"Burmah." By General Sir ARTHUR PHAYRE, G.C.M.G., K.C.S.I., C.B.

Members are requested to notice that it may be necessary to make alterations in the dates of the above papers.

CANTOR LECTURES.

Monday evenings, at eight o'clock:—

The Third Course will be on "The Scientific Principles involved in Electric Lighting," by Prof. W. G. ADAMS, F.R.S. Four Lectures.

Syllabus of the Course.

LECTURE III.—MARCH 21.

Use of magneto- and dynamo-electric machines for electric lighting. Electric lighting by means of the arc.

LECTURE IV.—MARCH 28.

Subdivisions of the electric current. Incandescent lamps. Luminous effects of electric currents in a vacuum, and in various gases.

The Fourth Course will be on "The Art of Lace-making," by ALAN S. COLE. Four Lectures.

April 4, 11; May 2, 9.

The Fifth Course will be on "Colour Blindness and its Influence upon Various Industries," by R. BRUDENELL CARTER, F.R.C.S. Three Lectures.

May 16, 23, 30.

ADMISSION TO MEETINGS.

Members have the right of attending all the Society's meetings and lectures. Every Member can admit *two* friends to the Ordinary and Sectional Meetings, and *one* friend to the Cantor Lectures. Books of tickets for the purpose have been issued to the Members, but admission can also be obtained *on the personal* introduction of a Member.

MEETINGS FOR THE ENSUING

MONDAY, MARCH 21ST...SOCIETY OF ART
Adelphi, W.C., 8 p.m. (Cantor Lectur
G. Adams, "The Scientific Princip
Electric Lighting." (Lecture III.)
Royal United Service Institution, Whiteh
Vice-Admiral J. H. Selwyn, "A
Hydraulic Propulsion."
Institute of Surveyors, 12, Great Geo
8 p.m. Resumed discussion on Mr.
paper, "Sanitation, as an important In
in House Property."
Medical, 11, Chandos-street, W., 8½ p.m.
Asiatic, 22, Albemarle-street, W., 3 p.m.
Victoria Institute, 7, Adelphi-terrace, W.
by Mr. J. F. Bateman.
London Institution, Finsbury-circus, E.
R. Bentley, "Fungi."

TUESDAY, MARCH 22ND...Royal Institution, Albe
3 p.m. Prof. E. A. Schäfer, "The Bloo
Medical and Chirurgical, 53, Berners-
street, W., 8½ p.m.
Civil Engineers, 25, Great George-stre
S.W., 8 p.m. Mr. David Phillips, "
Endurance of Iron and Mild Steel w
Corrosive Influences."
Anthropological Institute, 4, St. Marti
8 p.m. 1. Prof. W. H. Flower, "Arti
Skulls from Mallekolo." 2. Mr. Jose
Ethnological Bearings of the terms
and Romo."
Royal Colonial, the Grosvenor Gallery
Bond-street, W., 8 p.m. Mr. W. M.
"Imperial and Colonial Partnership i
Royal Horticultural, South Kensington,

WEDNESDAY, MARCH 23RD...SOCIETY OF AR
Adelphi, W.C., 8 p.m. Mr. Corneliu
Increasing Number of Deaths from
an Examination of the Causes."
Geological, Burlington-house, W., 8
Parkinson, "The Upper Greensands a
of the Isle of Wight." 2. Mr. Clem
Flow of an Ice-sheet, and its Connect
Phenomenon in Britain." 3. Dr. R.
"Soilcap Motion."
Royal Society of Literature, 4, St. Mart
8 p.m. Mr. C. F. Keary, "The G
Spurious in the Eddaic Mythology. I.
and of the Other World."
Royal College of Physicians, Pall-mall E
(Croonian Lectures.) "Influence of
upon the Nervous System." (Lecture

THURSDAY, MARCH 24TH...SOCIETY OF AR
Adelphi, W.C., 8 p.m. Prof. John Per
Development of Electrical Appliances.
Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p
London Institution, Finsbury-circus, E
Ernst Pauer, "The History of the
trated Musical Lecture.)
Society for the Encouragement of Fine
street, W., 8 p.m.
Royal Institution, Albemarle-street, W.,
Statham, "Ornament Historically an
sidered." (Lecture II.)
Inventors' Institute, 4, St. Martin's-plac
Royal Society Club, Willis's-rooms, St.
6 p.m.

FRIDAY, MARCH 25TH...SOCIETY OF ART
Adelphi, W.C., 8 p.m. (Indian Sect
Campbell, "The Tenure and Cultiva
India."
Royal College of Physicians, Pall-mall E
(Croonian Lectures.) "Influence of
upon the Nervous System." (Lecture
Royal United Service Institution, White
Lieut.-Col. Lonsdale A. H. Hale, "Out
by the Systems followed in Continenta
Royal Institution, Albemarle-street, W
A. Buchan, "The Weather and the He
Quekett Microscopical Club, Universit
8 p.m. Mr. J. G. Waller, "*Cliona*
Sponge make the Burrows?"
Clinical, 53, Berners-street, W., 8½ p.m.

SATURDAY, MARCH 26TH...Ladies' Sanitary As
HOUSE OF THE SOCIETY OF ARTS), 5½
Richardson, "Domestic Sanitation or
(Lecture VI.)
Physical, Science Schools, South Kensing
Geologists' Association, University Colle
Visit to the Museum of Practical G
street, under the direction of Mr. Fr
Royal Botanic, Inner-circle, Regent's-pa
Royal Institution, Albemarle-street, W.,
R. Haweis, "American Humorists."

INAL OF THE SOCIETY OF ARTS.

No. 1,479. Vol. XXIX.

FRIDAY, MARCH 25, 1881.

...nications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

CANTOR LECTURES.

...third lecture of the third course was de...l on Monday, 21st inst., by Professor W. G. ..., F.R.S., on "The Scientific Principles in... in Electric Lighting." The lecturer ...d the use of magneto- and dynamo-electric ...s for electric lighting, and electric lighting ...ns of the arc. The lecture was fully ...d by apparatus and lamps kindly lent following :—Mr. Berly, Jamin candles; ...ish Electric Light Company, two Gramme ..., Brockie lamp, and Serrin lamp; Brush Light Company, Brush lamp; Mr. Latimer ...ontin lamp, Wilde lamp, and models; Mr. ...n, Bürgin machine and armature, and ...n lamp; Messrs. Elliott and Co., Trow... electro-dynamometer; Messrs. Robey of Lincoln, a ten-horse power steam Dr. Siemens, F.R.S., early dynamo pendulum lamp, electro-dynamometer ...coder; Société Generale d'Electricité, ...off lamp. Diagrams were lent by Dr. ...m, F.R.S., and Mr. Shoolbred. The ... will be published during the summer

DOMESTIC ECONOMY CONGRESS.

...ting of the General Committee was held ...lay, 22nd. Present:—Lord Alfred S. ...ll (in the chair), Miss Rose Adams, the ... of Airlie, Mrs. G. C. T. Bartley, Lady ...yley, Miss Clive Bayley, Miss Bidder, ...kton, Miss Buckton, Lady Cole, Miss ...s King, Lady Dorothy Neville, Lady ...ussell, Miss Wetton; Sir Henry Cole, Major-General Cotton, C.S.I., Rev. J. P. ...pe, and Rev. Newton Price, with Mr. H. Wood, Secretary. The Committee con...and revised the Programme for the

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1881, early in May next. This medal was struck to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows :—

In 1864, to Sir Rowland Hill, K.C.B., F.R.S., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially, by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (afterwards Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S., "in recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For. Memb. R.S., Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. (now Sir) Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. (now Sir) Henry Bessemer, F.R.S., "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Michel Eugène Chevreul, For. Memb. R.S., "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to C. W. Siemens, D.C.L., F.R.S., "for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvement in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to the Manufactures and the Arts."

In 1875, to Michel Chevalier, "the distinguished French statesman, who, by his writings and persistent exertions, extending over many years, has rendered essential service in promoting Arts, Manufactures, and Commerce."

In 1876, to Sir George B. Airy, K.C.B., F.R.S., Astronomer Royal, "for eminent services rendered to Commerce by his researches in nautical astronomy, and in magnetism, and by his improvements in the application of the mariner's compass to the navigation of iron ships."

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., member of the Institute of France, "the distinguished chemist, whose researches have exercised a very material influence on the advancement of the Industrial Arts."

In 1878, to Sir Wm. G. Armstrong, C.B., D.C.L., F.R.S., "because of his distinction as an engineer and as a scientific man, and because by the development of the transmission of power—hydraulically—due to his constant efforts, extending over many years, the manufactures of this country have been greatly aided, and mechanical power beneficially substituted for most laborious and injurious manual labour."

In 1879, to Sir William Thomson, LL.D., D.C.L., F.R.S., "on account of the signal services rendered to Arts, Manufactures, and Commerce by his electrical researches, especially with reference to the transmission of telegraphic messages over ocean cables."

In 1880, to James Prescott Joule, LL.D., D.C.L., "for having established, after most laborious research, the true relation between heat, electricity, and mechanical work, thus affording to the engineer a sure guide in the application of science and industrial pursuits."

The Council invite members of the Society to forward to the Secretary, on or before the 23rd of April, the names of such men of high distinction as they may think worthy of this honour.

HOUSE SANITATION.

The Council offer the following Medals for the best Sanitary Arrangements in Houses built in the Metropolis, the plans of such arrangements to be exhibited in the Society's Rooms, Adelphi, in June, 1881, and to be sent in on or before 12th May, 1881:—

1. One Silver Medal for the best sanitary arrangements, carried out and in satisfactory working, in a house let out in tenements to artisans, for which a weekly rental is paid.

2. One Silver Medal for the best sanitary arrangements, in actual working, in a house of the yearly rental of £40, or less, to about £200 in value.

3. One Silver Medal for the best sanitary arrangements, in actual satisfactory working, in a house of the yearly rental value of £200 and upwards, to any amount.

4. The houses must be open to the inspection of the Judges, who, in considering their award, will be guided by the suggestions of plans for main sewerage, drainage, and water supply, made under the Public Health Act, 1875. The houses must have been in actual occupation within the last three months, and a Certificate must be given by the occupiers, on a printed form, stating the satisfactory working of all the sanitary arrangements, such form to be obtained at the Society of *Arts.*

5. The houses may be old, fitted sanitary arrangements, or may be must be within the metropolitan area of Works.

6. The sanitary arrangements mus conditions for good water supply, drai ing, and ventilation of the house, an taken against frost.

7. The medals may be awarded to of the houses, or the lessees, or the o

8. The plans must consist of a grou sections, to the scale of not less tha five feet; details of not less than o foot. The plans may be accompani cations.

9. The names of the architects, sanitary engineers who directed arrangements should be given, an will be awarded to those whose pl Medals.

PROCEEDINGS OF THE

SIXTEENTH ORDINARY ME

Wednesday, March 23rd, 1881; P ABEL, C.B., F.R.S., Vice-President in the chair.

The following candidates were election as members of the Society:-

Atkinson, John, Tosti, Falsgrave, Scarb
Bacon, George Washington, F.R.G.S. W.C.
Black, William, South Shields.
Lorimer, William, Messrs. Dübs and Co
Russell, William J., Ph.D., F.R.S., 34, ton-terrace, N.W.

The following candidates were ball duly elected members of the Society

Appleby, Francis James, The Rowans, S.E.
Bayley, Sir Edward Clive, K.C.S.I. Wilderness, Ascot.
Brass, John H., Wentworth-house, Chelsea, S.W.
Brothers, William, Meadow-head-h Blackburn.
Cahen, Albert, 7, Bayswater-hill, W.
Godfrey, William Bernard, 54, Regent's-
Jenkinson, Edward George, 26, Palace-g Kensington, W.
Ogg, Surgeon-Major G. S. W., 8, Hampstead, N.W.
Roper, Richard, 143, Lewisham High-r S.E.
Staight, Daniel George, 63, Tulse-hill, S
White, Frederick Anthony, Kinross-ho road, S.W., and 85, Gracechurch-stre

The paper read was—

CREASING NUMBER OF DEATHS EXPLOSIONS, WITH AN EXAMINA- F THE CAUSES.

Cornelius Walford, F.I.A., F.S.S.,
Barrister-at-Law.

be fully understood, at starting, that I pose to approach this topic from a nt of view. Observations, conducted ries of years mainly for statistical ve impressed upon my mind the con- explosions are far more numerous ive than they have been at any pre- This fact established, and the reasons plain, it will then remain for science edies in mitigation, or to declare why e done.

ecessary to seek far for the causes of d number of explosions in modern w forces are being constantly brought o meet the requirements of our manu- and mineral industries. Steam itself, ve have ceased to regard its application but a modern invention—regarded from f its practical application. It is, indeed, ries since the Marquis of Worcester he steam-engine in his "Century of In- " but it is very little more than one ce Watt's engine was first used as a er in a manufactory (1775); it is only present century that steam navigation a practical fact, and that steam has yed for the purpose of locomotion on One of the first fixed steam-engines ondon was that used for the purpose the *Times* newspaper, in 1814. The eration may be said to have witnessed application of steam to our daily

uth, it is not so much to the effects of ve trace the increasing risk of explosion. has long played an important part, its ng over some five or six centuries. n invention falling within the range of ; century, has been, perhaps, on the re deadly agent of destruction—in the entional explosions—than gunpowder; nical compounds of almost endless , finally, mineral oils, make up the sum ts which in the present day prove so to life and property.

pting to compare one period with the matter of destructiveness, we are on of requiring statistical records; for se is always more or less misleading, pable of comparison in the sense of There are practically no statistics rior to the returns resulting from the force of the Act of 1836, for the regis- eaths. But this Act only applied to of the kingdom (England and Wales), tailed causes of deaths were not, as a ct, published earlier than for the year not then in such a manner as to be r the purpose I now have in view.

THS CAUSED BY EXPLOSIONS.

rd report of the Registrar-General, the explosions in certain selected districts, tropolis, Birmingham, Manchester and Salford, Liverpool and West Derby (adjoining), the mining districts, and the agricultural districts of Norfolk and Suffolk, were returned as being 41 in the year 1838, all occurring to males. The proportion of deaths from explosions, scalds, burns, and lightning (all classed together), to 100,000 deaths from all causes was found to vary in different districts of the kingdom from 14·6 in the metropolis to 20·7 in Norfolk and Suffolk; 28·3 in Manchester, Liverpool, and Birmingham, up to 38·8 in the mining districts.

In the seventh report of the Registrar-General, it is shown that the deaths from explosions, in the year 1840, were at the rate of 19·4 per million of the population, viz., males, 19; females, 4.

For the next 12 years, these national records are silent on the subject of deaths from explosion. This was not because the question was overlooked, but the rather that a process of elaboration was being devised, whereby the violent deaths in England and Wales should be rendered capable of scientific classification. The arrangement propounded in the nineteenth report was to classify the total violent deaths under six leading divisions. 1. Connected with railways; 2. Connected with mines (coal and metals treated separately); 3. Mechanical injuries; 4. Chemical injuries; 5. Asphyxia (suspension of respiration); 6. Violence not otherwise classed.

Several of these divisions enumerated deaths from explosions. The first from explosion of boilers; the second (in each of its sub-divisions), explosions of fire-damp, and also of boilers. The third, boiler explosions (very numerous); the fourth, explosions of chemical compounds. Thus, in the five years, 1852-6, the deaths from explosions were as follows, under the several causes mentioned by the Registrar:—

	Males.	Females.	Total.
1. RAILWAYS:—			
Explosion of Boiler	12	—	12
2. MINES (COAL):—			
Explosion of Fire-damp	968	1	969
" Boiler	16	—	16
" (METAL):—			
Explosion of Fire-damp	3	—	3
" Boiler	6	—	6
3. MECHANICAL:—			
Explosion of Boiler	149	15	164
4. CHEMICAL:—			
Explosion of Gunpowder	72	16	88
" Camphine	—	1	1
" Gases	27	2	29
" Naphtha	7	—	7
" Sulphur and Nitrate of Silver	24	—	24
Explosion of Fireworks	28	6	34
Here we have a total of	...	...	1,373

Giving an average of 274·6 deaths from explosions in England and Wales for each of the years embraced in the period under observation.

It now becomes possible to commence the construction of a table, showing the annual deaths from explosions in England and Wales, but not continuously, for the returns in a corresponding

last reviewed were omitted during the -62, since which last date, however, inuous.

meration which recommenced in 1863, cluded some items which did not pre- ear, as, for instance, under "Coal ixplosions of Sulphur," and "Explo- tated how," these latter not including ing from "Blasting," which are sepa- ed, but are not included in my table; er Chemical are added "Gun-cotton," im," "Tar Boiler," "Manner not stated."

—SHOWING THE DEATHS FROM EXPLOSIONS NG DURING THE PERIOD 1852–1879 (ENGLAND ALES).

		Males.	Females.	Totals.	Bearing the proportion to the total violent deaths of the year, of 1 in
		290	6	296	48·9
		232	9	241	61·5
		297	12	309	49·1
		206	9	215	71·1
		307	5	312	47·8
	No returns	—	—	—	—
3		—	—	—	—
9		—	—	—	—
0		—	—	—	—
1		—	—	—	—
2		—	—	—	—
3		266	12	278	56·4
4		216	10	226	75·3
5		164	8	172	101·0
6		289	8	297	57·0
7		590	12	602	28·0
8		379	13	392	43·3
9		407	18	425	88·8
0		311	12	323	51·4
1		258	73	331	51·3
2		265	10	275	62·8
3		171	18	189	91·2
4		287	17	304	59·0
5		242	22	264	71·5
6		341	12	353	52·0
7		131	13	144	122·8
8		391	13	404	46·6
9		450	12	462	38·2
		6,490	324	6,814	
age he ars		295·0	14·8	309·8	

t will be seen that there are considerable fluctua- is in the annual number of deaths from explo- is. This was to be expected, from the nature of case, but they will be found mainly to arise m explosions of fire-damp in coal mines, with asional fluctuations from other causes. In view elucidating this point, I have prepared the owing table, showing the annual deaths from principal classes of explosions, as—1, fire-damp; oiler explosions; 3, chemical explosions; 4, un- ined causes (embracing both sexes). This at glance gives an indication of the cause of ctuation in any one year or at particular periods. One or two of the more prominent cases of fluc- tion, shown in Table B., may be made plain the following notes. Thus—

867. There were 320 male deaths, returned as m "Explosion, not stated how;" but most bly from fire-damp.

Under chemical injuries, were included 30 deaths by "steam;" probably steam, consequent upon explosi

1871. There were 63 deaths t to "gunpowder" explosion—a were classed under "chemicals.

TABLE B. — SHOWING THE AN EXPLOSIONS, CLASSED UNDER FO —1852-79—(ENGLAND AND WA

Year.		Fire-damp.	Boilers.	Chemicals.
1852		240	38	18
1853		194	16	31
1854		215	41	53
1855		128	41	46
1856		215	62	35
1857	No return.	—	—	—
1858		—	—	—
1859		—	—	—
1860		—	—	—
1861		—	—	—
1862		—	—	—
1863		178	62	38
1864		119	50	57
1865		74	51	44
1866		191	65	41
1867		169	42	71
1868		246	23	123
1869		274	57	94
1870		196	59	68
1871		149	16	166
1872		173	10	92
1873		89	22	78
1874		194	24	86
1875		127	38	99
1876		191	21	141
1877		72	26	46
1878		313	21	70
1879		372	37	53
		4,199	822	1,55
Average of the 22 years		187·2	37·4	7(

But apart from such m there is a clear lesson to b and it is this—that whil explosions show an almo fluctuating decrease of la from explosions of chemi although fluctuating inc little doubt that this latt danger to life and prope

WIDER RANGE OF

But, on the whole, these tables, while th deaths resulting from divisions of the Unit Wales—do not conv consequences annuall

For the other di land and Ireland, th Registrar-Generals the deaths resultin comprehended in "Violent deaths."

NON

The first point and necessarily s injuries. Death

t a very large proportion of the injuries om explosions do not terminate fatally. he experience of the Accident Insurnies—which is that 100 non-fatal r to each fatal injury—we have an nnual average of 30,970 injuries to , resulting from explosions of various gland and Wales alone.

his last estimate does not measure the nces of the resulting evils, for in the les killed, there are the widows and lly left unprovided for to be brought . And here it becomes important to es, at the time of death, of the vicsions. Taking one year, 1879, as an facts were as follows :—Of the total there were at ages under 15, 52 ; at 2; 20-25, 69; 25-35, 136; 35-45, 74; 55-65, 19; 65-75, 2; 75-85, 1. So reat majority of instances, the persons nilies dependent upon them.

PROPERTY DESTROYED.

present exists no means of even estiexactitude the amount of property troyed by explosions. It is somest, as witness the consequences of the plosion, 1854 (referred to, in detail, nical Stores," later in this paper); and eapolis Flour Mills, 1878 (spoken of tail, under title, "Flouring Mills," But this point will be again referred

CALITIES OF EXPLOSIONS.

completeness, it is desirable, at this ice the localities of explosions, as ine recorded deaths. For the purposes nal death registration, England and ided into 11 geographical registration follows :—

	VII. North Midland.
stern.	VIII. North-Western.
dland.	IX. Yorkshire.
	X. Northern Counties.
'estern.	XI. Monmouthshire and
dland.	Wales.

s in 1879 were spread over these ollows :—

v.	vi.	vii.	viii.	ix.	x.	xi.	
5	31	5	27	35	7	331	— Total 462.

on of collieries subject to explosion ap, determines the divisions wherein number of deaths from explosions occur.

ECORDS OF EXPLOSIONS, AND THEIR CAUSES.

w, I believe, exhausted all the availof statistical information, I still feel lts presented are by no means adeimportance of the inquiry which I aken; and it, therefore, becomes consider what further process of elube made available. This can, I think, omplished by reviewing the chief xplosions" in separate detail; and I roceed upon this new line of inquiry. branches of inquiry in alphabetical order. I cannot pretend to make some of the sections exhaustive; they must be regarded as illustrative only.

CHEMICAL COMPOUNDS AND PROCESSES.— ILLUSTRATIVE CASES.

1854.—October 6. Gateshead and Newcastle.— Fire broke out in a worsted manufactory adjoining a bonded warehouse. This latter was considered to be a double fire-proof structure, being supported on metal pillars and floors, and lined throughout with iron-sheeting. In this building was stored a large variety of chemical stores, and amongst these 47 tons of sulphur in one vault, covered with a tarpaulin to protect it; but on this tarpaulin was placed 45 tons of nitrate of soda. There was no gunpowder, charcoal, saltpetre, or naphtha stored there. The fire in the worsted warehouse caused the brickwork of the bonded warehouse to crumble away, and, ultimately, nothing remained on one side but the red-hot skeleton of the building. Some workmen, who had been engaged with nitrate of soda, predicted that it would explode, but this view was not generally entertained. Finally, one of the most terrible explosions of which we have any record in this country, occurred. By means of it the shipping on the River Tyne became ignited, and the fire was thus carried across the river into Newcastle, where many houses were burned, and others seriously damaged by the explosion. The property destroyed was estimated to have been of the value of £600,000, the loss mostly falling upon insurance offices.

An inquiry into the cause of the explosion was instituted, and in view of making its results clear, it is necessary to state that the chemical stores in the warehouse, beyond those already named, consisted of guano, alkali, fullers'-earth, ammoniacal charcoal, potash, yellow ochre, bone-ash, arsenic, zinc, iron, lead, magnesia, alum, and coaltar. Mr. Hugh Lee Pattison, chemical manufacturer, being called as a witness, said he was of opinion that none of the substances named were explosive, *per se*; that no two would be explosive by being rudely mixed together; perhaps hardly any three of them would become explosive by being so mixed. He had made experiments for this occasion, and had melted nitrate of soda, and when perfectly fluid and red-hot had poured into it melted brimstone. There was produced certainly intense heat, but no explosion. Another element was therefore wanted, and that element was water. There was, he said, abundant evidence that when water comes in contact with intensely heated and melted saline matter, instant explosion takes place. It would be essential for the amount of water to produce its full effect, that it should fall upon the tested saline mass at once. A pint of water would cause a loud explosion. He of course thought it very unsafe to have such a quantity of combustible matter so placed as had been the case here; but he might have added that it was the efforts of the fire-brigade to extinguish the fire, by the applicacation of water, that caused the explosion.

1867.—Fire occurred on premises where the business carried on was that of extracting oil from shoddy, the process being the following:—The shoddy is placed in an "extractor," into which is pumped from below bi-sulphide of carbon; this,

rising through the shoddy, disengages the oil, which flows off through a hole in the top of the extractor. The bi-sulphide is next drawn off, and steam introduced, which carries off the residue of of the bi-sulphide and oil remaining in the extractor into a still, where they are separated. The vapour which thus passes from the extractor is condensible at a temperature of about 109° Fahr. This vapour is highly inflammable, and, when mixed with air in the proportion of 1 to 15, is explosive. In the present case there was a leakage in the gaskin (or packing of canvas), which lies between the lid and rim of the extractor, coupled with a stoppage in the pipe between the extractor and the still. The vapour, escaping through the hole, ignited at the lamp, and set fire to some bags lying near; finally, the vapour becoming sufficiently mixed with the air, exploded, and caused considerable damage to the building, out of which arose the important insurance case, Stanley *v.* Western Insurance Co., 1868. This is a type of a large class of explosions in connection with chemical processes.

1878.—In Paris, on 15th May, this year, an explosion of chemical compounds occurred on the premises of a toy manufacturer, in the Rue Beranger, a leading thoroughfare of the city, whereby nearly 100 persons were killed or injured, and much property was destroyed.

1879. — Serious explosion in Newark, New Jersey, United States. The process being carried on was that of manufacturing celluloid. This substance is a species of solidified collodion, produced by dissolving gun-cotton (pyroxylin) in camphor, with the aid of heat and pressure. The gun-cotton is ground in water to a fine pulp, in a machine similar to that used in grinding paper pulp. The pulp is then subjected to powerful pressure in a perforated vessel, to extract the bulk of moisture, but still leaving it slightly moist for the next operation. This consists in thoroughly incorporating finely comminuted gum camphor with the moist gun-cotton pulp. The proportions employed are understood to be one part by weight of camphor to two parts by weight of pulp. After final pressure to expel the remaining moisture, the substance is cast in moulds to the form required, and constitutes an excellent substitute for ivory. It is now being used, combined with linen, for the manufacture of cuffs, collars, and shirt fronts, with many other articles of common use. It is liable to explode in several of its stages; and it may be regarded as presenting one of the newest dangers with which we are familiar. In the particular instance before us, how the materials ignited—whether by spontaneous combustion or otherwise—is not known. The substance is highly inflammable, as well as explosive, and demands the aid of science to provide an antidote for its dangers.

In the processes of distilling ardent spirits, carried on largely in thickly populated districts, there is always the risk of explosion, either (1) in the process retracting the crude spirit from the substance operated upon; or (2) in refining the spirit so obtained, especially the latter. But here the aid of science has been rendered largely available.

It seems desirable to give some further details regarding explosions of this class, hence I have prepared the following table:—

TABLE C.—EXPLOSIONS OF CHEMICAL COMPOUNDS OTHERWISE THAN GUNPO
WORKS.

1837.	June 24....	At Blaina Ironworks (Monmo much damage to property accumulated in a disuse works. (See 1855.)
1842.	May 6. ...	Hodge's Distillery. Explosi spirits, a large quant destroyed.
1847.	July ...	Hall's Gun-cotton Factory, Fa and great destruction of p to have originated throu premises.
1854.	Oct. 6......	Chemical stores in bonded wa Details already given.
1855.	Dec. 14. ...	Explosion at iron furnace, Bil about six tons of molte cinders were blown ab killed. (See 1837.)
1867.	Dec. 17. ...	On Newcastle-moor; two case taken there to be destroy ing Mr. Bryson, town superintending.
	Dec. 17....	See the case of distilling oi mentioned in the text.
1869.	June 30....	Near Carnarvon; two ca glycerine; 5 killed, and da round.
1870.	Sept. 11....	Greenock; nitro-glycerine; 5 taken shelter in the unoc small tin can of the com on the wall, killed.
1871.	Aug. 11....	Prentice's Gun-cotton Manuf (Suffolk); 20 killed, 70 i destruction of property. wilfully occasioned by th at a certain stage of the p
1872.	Aug. 1. ...	Experiments with gun-cotto hood of the Treasury; w general alarm.
1875.	May 27. ...	Chemical store, Washington- 5 killed, 17 wounded; ho
1877.	Dec. 19. ...	Great explosion of dynamite Gothard Tunnel (Switzer
	Dec. 19. ...	A dynamite factory at Geron
1878.	May 10. ...	Part of freight on board Al while in Loch Foyle; 5 k The entire ship and cargo
	May 17. ...	Dynamite at Nobel's factory, shire); 2 killed.
	July 3. ...	Dynamite at the Yarlside Mi Furness.
1879.	May 16. ...	At the Patent Cotton Gunpow Faversham; 1 killed.
	June ...	Detonators at the Home-offic wich.—It appeared that t 12,000 in number, were police, under an order fr having been found imp unregistered on board a burg. They were intend poses, and were found o copper tubes, charged mercury. There was verting them to Governm principal foreman of the ported that this could no a loss, and he recommen be destroyed by being pla diluted nitric acid. Th was approved by Profes War Department chemist small quantities of det manner, and he now ex dent was due to the mi the operation on too larg of the 12,000 detonators the water at once, and b could have become tho nitric acid was poured i chemical excitement suc particle of the mercury plosion.
	Nov. 7. ...	At Templecombe (Dorset); exploded from contact w
1880.	March 5....	At Craig (near Montrose) killed and 1 injured.
	April ...	Tar-distilling works at Silve several injured. [First a
	April 26....	Benzine at a druggist's in A killed and 8 injured.
	April 28 ...	Cork; the extensive premises chemists and oil merc plosions.

'4. ...Dynamite in a railway waggon, at Stratford, Ontario; 2 killed and others wounded.

5. ...At Messrs. Hodgkinson's, wholesale druggists, Aldersgate-street. Vapour from aniseed, heated by gas; several killed; great destruction of property.

...Dynamite magazine of St. Gothard Railway (Faido); 18 killed and wounded. From 40,000 to 60,000 cartridges exploded.

...The ship, *Sapphire* of Antwerp), in Philadelphia Docks; cargo exploded.

...At the Runnymede Engineering Works, Egham, Surrey.—A group of buildings used by Mr. Postlethwaite for the construction of torpedo and other steam-launches. The establishment is in close proximity to the Thames, and is surrounded by waste land, upon a portion of which a Norwegian gentleman has been engaged in the composition of a new fulminate for the detonating caps of the torpedoes used in naval warfare. A cask of this new composition, which, when first mixed, looks very much like ale with yeast on the surface, had been left in a small temporary wooden building, situated about 50 yards from the works, in order that the material might get dried by evaporation; and the substance, heated by the sun, or fired by a flash of lightning, suddenly exploded, with a sound like a clap of thunder. The temporary shed and its contents were blown to atoms, and a piece of the *débris* slightly wounded a boy who was fishing 60 yards off on the river bank. Very fortunately, the men had left work.

Aug. 7. ...In the laboratory, Government Arsenal, Bridesburg, Philadelphia; 2 killed, 10 wounded.

Aug. 13...Benzine in ship, *Hansa*, in Lubeck Harbour; 12 persons injured, and ship much burned.

Nov. 13...At Her Majesty's Theatre; explosion from accident to lime-light.

:—Experiments were made in December, 1880, by the of the Royal Arsenal, Woolwich, in company with Mr. her Majesty's Inspector of Mines, and Major Majendie, Artillery, the Inspector of Explosives, with the view of ing, if possible, the cause of the accidental firing of blastges in mines and quarries. Serious consequences have ly resulted from the deterioration of these charges while ribly driven into the borings, and many men have been from this cause. Great uncertainty exists as to the conwhich create or contribute to the premature ignition, and, s, a day was devoted to experiments, in the hope of elucime information on the subject, and perhaps avoiding the ce of such accidents in future. Charges of gunpowder rdingly subjected to violent treatment of various kinds, hey might meet with under most unfavourable circumsactual practice; but in no case did blows or pressure st an explosion, however excessive the application.

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is a miscellaneous table, designed to show ied circumstances under which explosives plosive compounds work destruction to life perty; and new compounds are constantly iscovered. I am glad to see that experire being made from time to time, in view ning the explosive force during the transsubstances required in considerable quan-Regarding explosions on board ship—a of the greatest danger—it is clear that more egulations than any heretofore in force are l.

Explosions in Collieries.

of the most frequent, as well as one of t destructive forms of explosion, is that e-damp in collieries. In certain districts kingdom, such events are of common ce, and the sacrifice of life is immense. in the discovery of the safety lamp, and by other means, has already lent remedial aid. e to think that it may yet accomplish much d in a direction which I shall hereafter I propose now to give a table of the portant of such explosions during the reign, drawing largely in the middle portions upon the data contained in Mr. Neison's "Preliminary Report" on the rate of fatal and non-fatal accidents in and about mines and railways, 1880.

Table D.—Explosions in Coal Mines Resulting in the Death of Five Persons and Upwards, 1838-80 (United Kingdom).

Note.—These resulted from Fire-damp, unless otherwise stated.

Date.	Colliery and Location.	No. of Lives Lost.	Observations.
1838. Oct. 24..	"John Pitt" (Whitehaven) ...	35	
1839. Feb. 18..	"William" (Cumberland)......	23	
June 28.	St. Hilda's (S. Shields)............	60	
1841. Aug. 6...	Thornley (Sunderland)	9	
1843. April 7..	Stormont (Newcastle)	27	
1844. Sept. 28.	Haswell (Durham)	95	
1845. Aug. 2...	Cwmbach (Merthyr)	28	
Aug. 21.	Jarrow (S. Shields)	39	6 explosions in 28 years.
1846. Jan. 14..	Risca (S. Wales).....................	35	(See 1853.)
1847. March 5	Oaks (Barnsley)......................	70	(See 1865.)
June 29.	Kirklep Hall (Wigan)............	18	
1848. Aug. 17.	Newton (Seaham)..................	14	
Oct. 28..	Whinnyhill (Whitehaven).......	30	
1849. Jan. 24..	Darnley Main (Barnsley)	75	
March 6	Middle Patricroft (Wigan)......	12	
June 5...	Hebburn (Newcastle)	33	
Aug. 11.	Lletty Skenken (Aberdare) ...	52	
1850. Nov. 16.	"Rock Pit" (Haydock)	11	
July 23..	Commonbend (Airdrie)	20	
Nov. 11.	Houghton (Durham)	26	
1851. Mar. 15.	Nitshill (Paisley)	61	
Mar. 25.	Arley (Wigan)	58	
Aug. 18.	Washington (Newcastle)	35	
Dec. 20..	Rawmark (Rotherham)	52	
1852. May 20..	Downbrow (Preston)	35	
1853. Mar. 12.	Risca (S. Wales)	10	(See 1846 & 1860.)
July 1 ...	Bent Grange (Oldham	17	
1854. July 18..	Arley (Wigan)	189	
1856. July 15..	Cymmer (Pontypridd)	14	
Aug. 12.	Ramrod (Oldbury)	111	
1857. Feb. 19..	Land Hill (Barnsley)	89	
Aug. 2..	Hays (Ashton)	40	
1858. Feb. 2...	Bordsley, (Ashton-under-Lyne	50	
Feb. 24..	Lower Duffryn (S. Wales)......	20	(See 1860.)
Oct. 1....	Pagebank (Durham)..............	10	
Oct. 13 ..	Primrose Swansea)...............	13	
1859. Mar. 20.	South Killoe (Durham)	5	
1860. Feb. 15..	Higham (Yorks)	13	
Mar. 3...	Burradon (Northumberland)...	76	
Aug. 3...	Winstanley (W. Lancashire)...	13	
Nov. 6...	Lower Duffryn (S. Wales) ...	12	(See 1858.)
Dec. 1 ...	Black Vein (Monmouth).........	142	
Dec. 20..	Mirror Pit (S. Durham)	22	
1861. Feb. 6 ...	Brereton S. Durham)	7	
Feb. 27..	Linnyshaw (N. Lancashire) ...	9	
Mar. 8...	Blaengwawr (S. Wales)	13	
Sept. 26.	South Mostyn (W. Lancashire)	10	
Nov. 1...	Sherrington (W. Lancashire)...	13	
1862. Feb. 19..	Cittim (S. Wales)	47	(See 1865.)
April 4..	Westwood (Yorks)	6	
Nov. 22..	Walker (Northumberland)......	16	
Dec. 8 ...	Edmund's Main (Barnsley)......	59	
1863. Mar. 6...	Coxlodge (Northumberland) ...	26	
June 26.	Park (S. Wales)	6	
Oct. 17..	Morfa (S. Wales)	39	(See 1870.)
Dec. 9...	Wynstay (W. Lancashire)	13	(See 1868.)
1864. Mar. 2...	Brookhouse (N. Staffordshire).	5	
Sept. 9 ..	Seghill (Northumberland)	7	
1865. Mar. 1...	Clough Hall (N. Staffordshire)	5	
May 3 ...	Clay Cross (Derbyshire	8	
June 16.	Tredegar (Monmouthshire)....	26	
Dec. 20..	Cittim (S. Wales)	34	(See 1862.)
1866. July 23..	Park-lane (W. Lancashire)......	30	
May 4...	Garswood-pk. (W. Lancashire)	12	
June 14.	Dunkinfield (N. Staffordshire).	38	
Oct. 31..	Pelton (S. Durham)	24	
Dec. 10..	Bank (N. Lancashire)	8	
Dec. 12..	Oaks (Barnsley).....................	334	(See 1847.)
Dec. 13..	Oaks (Barnsley).....................	27	
Dec. 13..	Talk-o'-th'-Hill (N. Staffordshire)	91	
1867. May 30..	Mesne Lea (N. Lincolnshire)...	7	
Aug. 20.	Garswood-pk. (W. Lancashire)	14	
Nov. 8...	Ferndale (S. Wales)	178	(See 1869.)
Nov. 12.	Hornerhill (S. Staffordshire)...	12	

Date.		Colliery and Location.	No. of Lives Lost.	Observations.
1868.	Sept. 30.	Wynstay (W. Lancashire)	10	(See 1863 & 1873.)
	Oct. 2 ...	Green Pit, Ruabon	10	Many injured.
	Nov. 25.	Hindley-green (W. Lancashire)	62	
	Dec. 21..	Morley (W. Lancashire)	8	
	Dec. 26..	Haydock (W. Lancashire)	26	(See 1869.)
1869.	July 29..	Springwell (Northumberland).	5	
	April 1..	High Brooks (W. Lancashire).	37	
	May 25..	Cwmnantddu (Monmouth)......	7	
	June 10.	Ferndale (S. Wales)	53	(See 1867.)
	July 21..	Haydock (W. Lancashire)	59	(See 1868 & 1878.)
	Aug. 2...	Burg (near Dresden)	269	
	Oct. 22..	Newbury (Monmouth)............	11	
	Nov. 11..	Hendreforgan (S. Wales)	6	
	Nov. 15..	Low Hall (W. Lancashire)......	27	
1870.	Feb. 4 ...	Pendleton (N. Lancashire)......	9	
	Feb. 14..	Morfa (S. Wales)	30	(See 1863.)
	Mar. 4...	Dunkirk (N. Staffordshire) ...	9	
	July 7 ...	Silverdale (N. Staffordshire)...	19	(See 1872.)
	July 23..	Charles (S. Wales)	19	
	Aug. 19.	Bryn Hall (W. Lancashire) ...	20	
	Sept. 27.	Pendlebury (N. Lancashire) ...	6	
	Oct. 8 ...	Abercromby (S. Wales)	5	
1871.	Jan. 10..	Renishaw-park (Derbyshire)...	26	
	Jan. 12..	Leycett (N. Staffordshire)	8	
	Feb. 24..	Pentre (S. Wales)	38	
	Mar. 2...	Victoria (Monmouthshire)	19	
	Sept. 6..	Ince Moss (W. Lancashire) ...	70	
	Sept. 20.	Ince Moss (W. Lancashire) ...	5	
	Oct. 25...	Seaham (S. Durham)	26	
	Nov. 15..	Hindley Green (W. Lancashire)	6	
	Nov. 22..	Norwood (Derbyshire)............	9	
1872.	Feb. 14..	Maesteg (S. Wales)	11	
	Mar. 12.	Berry Hill (N. Staffordshire)...	6	
	Mar. 28.	Lover's Lane (N. Lancashire).	27	
	Oct. 7 ...	Morley (Yorks)	34	
	Dec. 21..	Silverdale (N. Staffordshire)...	8	(See 1870.)
1873.	Feb. 18..	Falke (N. Staffordshire)	18	
	April 5..	Tillery (Monmouth)	6	
	April 24.	Wynstay (W. Lancashire)	7	(See 1863 & 1868.)
	May 31..	Bryn Hall (W. Lancashire).....	6	(See 1870.)
	Nov. 21.	Mesnes (W. Lancashire).........	7	
	Dec. 2 ...	Hafod (W. Lancashire)	5	
1874.	April 14.	Astley Pit (N. Staffordshire)...	54	
	July 18..	Ince Hall (W. Lancashire)......	15	
	Nov. 20.	Rowmarsh (Yorkshhire)	23	
	Dec. 7 ...	Ogmore (S. Wales)	5	
	Dec. 24..	Bignall-hall (N. Staffordshire).	17	
1875.	Jan. 5 ...	Aldwarke (Yorks)..................	7	
	April 30.	Bunker's Hill (N. Staffordshire)	43	
	Dec. 4 ...	New Tredegar (Monmouth.)...	23	
	Dec. 6 ...	Swaithe Maine (Yorks)	143	
	Dec. 6 ...	Llan (S. Wales)......................	16	
	Dec. 9 ...	Methley (Yorks)	6	
1876.	Jan. 5...	Jammage (N. Staffordshire) ...	5	
	April 6..	Silverdale (N. Staffordshire)...	5	
	June 26.	Birley (Derbyshire)	6	
	Dec. 18 .	S. Wales (Monmouth)	23	
1877.	Jan. 23..	Stonehill (N. Lancashire)	18	
	Feb. 7 ...	Foggs (N. Lancashire)............	10	
	Mar. 6...	Great Boys (N. Lancashire) ...	8	
	Mar. 10.	Weigfoch (S. Wales)	18	
	Oct. 11..	Pemberton (W. Lancashire) ...	36	
	Oct. 22..	Blantyre (E. Scotland)............	207	
1878.	Feb. 17..	Whiston (W. Lancashire)	7	
	Mar. 8...	Barrwood (W. Scotland).........	17	
	Mar. 12.	Unity Brook (N. Lancashire)...	43	
	Mar. 27.	Apeldale (N. Staffordshire) ...	23	
	May 30..	Pendwll (W. Lancashire)	6	
	June 7...	Haydock (W. Lancashire)	189	(See 1868-9.)
	Sept. 11.	Abercarn (Monmouthshire) ...	268	
1879.	Jan. 13...	Dinas (S. Wales)	64	
	Jan. 24	Fitzwilliam Hemsworth (Barnsley)	5	1st explosion.
	Mar. 4	"Deep Drop," or Silkstone Pit (Wakefield)	19	
	Ap. 16	Agrappe, Mons. (Belgium)......	240	(See 1880.)
		Short-heath (Staffordshire) ...	6	
	Dec. 24..	Kersley (near Bolton)	7	
1880.	Jan. 21..	Leycett (N. Staffordshire)	?	
	July 14..	Risca, Newport (S. Wales)......	119	(See 1846 & 1853.)
	Aug. 3 ..	Benham, Wrexham (N. Wales)	8	
	Sept. 8 ..	Seaham (Durham)..................	165	
	Nov. 19	Grand Buisson, Mons. (Belgium)	27	(See 1879.)
	Dec. 10	Pen-y-Graig, Rhondda (S. Wales..............................	101	

The result of the 156 colli
enumerated in this table, summaris
stands as follows :—

	No. of casualties.	No. of deaths resulting.		c
Jan.	13	278	July ..	
Feb.	18	580	Aug. ..	
Mar.	20	531	Sept. ..	
April	9	425	Oct. ..	
May	7	81	Nov. ..	
June	9	424	Dec. ..	

The lightest month is, therefore, M
number of casualties and the resul
together; July has one more casua
heavier mortality; April and Ju
then September; January, Augus
have a like number of casualties, b
months the fatality has been much
November is heavy; but the thre
months are February, March, and
latter more especially so. Now an
the state of the barometer and therr
a series of years should surely th
upon the causes then in operation,
indicate the means of future avoid
section "Dust."

The most fatal year embrace
appears to have been 1866—accour
great catastrophe at the "Oaks" (
ley, where poor Jeffcock voluntaril
life in a vain endeavour to affo
1880 is also a very heavy yea
1868 and 1873 were each remarkabl
Lancashire; whilst 1877 stands ou
of coal-mining in Scotland with fa
It is, indeed, noticeable how certair
appear to become disturbed at
and then remain quiescent for years
influences in any degree account fo
added a few casualties.

The inspection of collieries was
1850, by 13 and 14 Vict. c. 100.
were introduced in 1855, by 18 and
and again in 1860 by 23 and 24 V
1872, by 35 and 36 Vict. c. 76, the
the preceding measures were co
amended, and boys were prohibite
in collieries. In 1862, an Act was p
it incumbent upon colliery proprie
duplicate shafts.

Attention was, in 1879, directed
Academy to a case of explosion of car
occurred in July of that year in one
of Rochebelle (Gard). The coal strat
dislocated, and the carbonic acid, g
fully in the neighbourhood, and
through natural passages, seems to
lated in certain parts with suffic
explode with two loud detonations
quantity of fine coal into the galler
were asphyxiated, and two others v
throw themselves in a swooning st
and be hauled up. That no flame w
explosions of fire-damp) is proved
of burns on the bodies of the victin
blasting cartridges did not go off, ar
stances. The gas is thought to h
sulphuric acid (produced through
stratified mass of pyrites) dissolving

lfinding its way down to triassic limestone. rks of M. Kuhlmann, lately, an alembic , about 90 centimètres diameter, used for daily some 6,000 to 7,000 kilog. of consulphuric acid, was exploded, the comeces being shattered and thrown out, s of the fire-place, 20 to 30 mètres in irections. Fortunately a slight hissing red a few seconds previously, so that the had time to escape a terrible fate. of the explosion M. Kuhlmann supposes ollows:—This platinum apparatus was ned; some 30 to 40 kilogrammes of consulphuric acid had been left in it; on water had been admitted through the d the whole had been gently heated ur hours. It is known that mixing suld with water produces a good deal of the present instance, combination is have taken place instantaneously at a perature, generating a large amount From data furnished by Fabre and n, it appears that 40 kilogrammes of , with water, is capable of producing, ously, 18 to 20 cubic mètres of vapour, sufficient to explode a platinum vessel 0 litres capacity, and only 2 to 3 mm. As the combination occurred at about rce would be greater. M. Kuhlmann l the explosion several times in laboraments, and he finds that it always great violence where the quantity of least ten equivalents for one of acid. of the difficulty of mixing these two which have a very great affinity, but of which is so different that they may eral hours one on the other without l consequent combination, the need of nagement is obvious.

are now being brought forward for ieries with the electric light; this does o me, in the nature of the case, to be ing the position in which the men have their seams especially; but where it , safety should result.

now sitting a Royal Commission on in coal mines, whose report will be ard to with much interest.

DUST.

ng known that dust was highly inefore it was at all suspected that it ive. An instance of its intense iny was particularly recorded in the case mill at Millville, Massachusetts. The ere lighting the gas in the cardingust and fibre hanging to the gas-pipe in an instant the flames had spread er the room, and the building was stroyed. Later instances have been lly observed. But, in truth, the into the destruction of the Tradeston gow, had already determined that combined with the atmosphere in ortions, is explosive. Why not, then, pulverised substances?

EXPLOSIONS ARISING FROM DUST OF VARIOUS DESCRIPTIONS.

Brewery (Messrs. Alsopp's), Burton-on-Trent.—A workman provided with an unprotected light, shortly after the starting of some new works, on attempting to make an examination of the working of a leather band, was met, on the opening of the door leading into the casing, with an explosion sufficiently powerful to throw the band out of gear.

Another brewer has since stated that no less than three explosions had occurred on his premises. Hence the pulverised malt combs must be held to be explosive when mixed with the air, by the rapid movement of the machinery, or otherwise.

1877. Dec. 20.....At a wholesale candy establishment (Mr. Greenfield's) in New York; two lives lost, and much property destroyed. The opinion of experts, after it was found that the boiler had not exploded, was that gas had accumulated in the flue connecting the boilers with the chimney; but subsequent events leave no doubt that it was occasioned by dust, evolved in the manufacturing the candy on the premises. The loss to the insurance offices was very large. (See August, 1879).

1879. ...An explosion occurred, which gave rise to the theory that coal-dust will explode under certain conditions. Mr. Morrison, of Newcastle, tried experiments with anthracite coal-dust. He found this would, under certain conditions, ignite in a safety lamp.

August ....Another explosion in a French candy factory in New York.—A workman, while bearing a tray containing moulds of pulverised cornstarch in the drying-room, stumbled and fell; the falling threw a heavy cloud of finely-divided starch-dust against a red-hot furnace; an instant explosion resulted. It was found the moulds had become so dry, and so highly inflammable from constant use, that only a rude shake was needed to fill the air with explosive particles.

Nov. 7......In Kansas City, at a cracker (biscuit) and candy factory; 7 killed, and much property destroyed; fire following explosion.

The facts here noticed gave rise to a new theory, viz., that explosions in coal mines might sometimes arise from coal-dust, instead of fire-damp; Mr. W. Galloway therefore commenced a series of experiments, and communicated the results to the Royal Society. He stated that a certain mixture of air and coal-dust, not inflammable at ordinary pressure and temperature, becomes so when 0·892 per cent. of fire-damp (by volume) or more is added. It then burns freely with a red, smoky flame. In a dry and dusty mine an explosion may, he said, extend itself to remote parts of the workings where fire-damp is quite unsuspected. The wetness or dryness of the workings he stated to depend on the temperature of the strata in which they are situated, for if the temperature of the mine is lower than the dew point of the air at the surface, the ventilating current will deposit moisture as it becomes cooled in passing through the workings; and if, on the other hand, the temperature of the mine is higher than the dew point at the surface, the ventilating current will absorb moisture and tend to produce a state of dryness. He then pointed out that the temperature of the strata in the coal measures of this country increases at the rate of about 1° Fahr. for every 60 ft. below the surface, and therefore the comparative wetness or dryness of a mine depends on its depth. He has found that his own observations gave these results—that mines shallower than 400 ft. are damp, and those deeper than 700 ft. are dry and dusty. Between the 400 ft. and 700 ft. there is a kind of debatable ground, in which wetness or dryness depends for the time being on the temperature of the air entering the mine at the surface. In all dry coal mines the coal-dust lying on the floor of the roadway rises in clouds and fills the air when it is disturbed by the passage of men,

horses, and wagons, and a sudden puff of air such as that produced by a local explosion of fire-damp, or by a shot blowing its tamping, must necessarily produce the same effect in a greater or less degree, according to its intensity. Although 0·892 per cent. of fire-damp will cause an explosion, it is probable that under compression in a confined space a less amount may have the same effect.

Mr. Galloway propounded the theory that some kinds of coal-dust may, perhaps, require less fire-damp than others to render their mixture with air inflammable, and suggested that still other kinds may form inflammable mixtures with pure air. On the other hand, he mentioned an experiment with the return air of a mine where he found that the air had to be black with dust before ignition occurred. He mentioned that it was a favourite theory that fire-damp suddenly bursting from strata would cause an explosion of wide extent, and that traces of it could afterwards be found in the charring of the timber used in the mine. This so-called appearance of charring was, he said, due to a coating of the coked coal-dust adhering superficially. The practical suggestion made was that roadways in mines should be kept well watered to lay the coal-dust. In the case of the Dinas explosion (of the 13th of January), he had found on his last visit before the explosion that the water-carts were not being used. The manner, he said, in which coal-dust operates in setting fire to coal and timber is probably as follows:—The air is travelling rapidly in one direction along a gallery, throwing a continuous shower of dust, small pieces of coal, &c., against all surfaces in its course; at the instant the flame traverses it the coal-dust is melted; it then assumes the properties of flaming pitch, adheres to the surfaces against which it is thrown, and rapidly accumulates until it forms a crust of a greater or less thickness, according to the length of time the air continues to travel in the same direction. If there is enough air it will continue to burn, but if not it is soon extinguished, and a covering of "coke" results, and there is the appearance vulgarly call "charring." This throws a new light upon the circumstances attending colliery explosions in certain cases, and one which we may be sure scientific men will follow up.

Fireworks, Gun Caps, Cartridges, Rockets, and War Munitions.

Fireworks, employed for amusement, as also the more serious munitions employed in warfare, and the manufacture of sporting cartridges, &c., have been, and still are, attended with great danger; although legislation has done something to insure greater safety. I propose here to record some of the more serious casualties resulting from these causes:—

Table F.—Explosions arising in the Manufacture of Fireworks and Munitions for Sporting and Warfare.

1715. Jan. 13 ...Firework maker, Thames-street, London. Fireworks were being made on a large scale, in preparation for the king's coming to St. Paul's. 37 barrels of powder on the premises. The house blew up, and the ruins spread into a large conflagration, consuming more than 100 buildings. It is recorded, as an historical incident, that a child in its cradle was blown ... a neighbouring church, and its life

1766. July.........America.—At Hart
of 22 young ge
school-house
rejoicings that
being received
(by the British
gunpowder in u
in the lower ro
boy, seeing som
raked them to
exploded the c
ing into fragm
three.

Another explosion
on the same o
details.

1842. March 1 ...D'Ernst's firework
—all employed.

May 4......At Apothecaries'
bomb-shell du
killed, and buil

1845. Sept. 17 ...Royal Arsenal, W
stance from o
much property

1849. Oct. 12 ...Barling's firework

1850. Sept. 16 ...Firework factory i
destroying the
houses; injuri

1851. Dec. 2......Rocket factory, De

1854. March 6 ...Firework manuf
killed.

1855. Oct. 7 ......Firework manufac
lightning.

1857. Feb. 26 ...Fog-signal factory
Stratford; 3
destroyed.

1858. ......Bennett's firework
road; 5 killed,

1859. Sep. 27 ...Phillips and Pursal
Birmingham,
of finishing,
to 4,000 cartri
explosive ma
building destr

1861. Jan. 21 ...At Chatham Arsen
grenade in pr
minor explos
great destruc

1862. July 21 ...Walker's percu
killed, 14 s
destroyed.

1865. Sept. 21 ...Firework manu

Sept. 26 ...Firework manu

1867. Oct. 9 ......Hammond's fi
Edinburgh

1868. May 29 ...Fog-signal ma

Sept. 18 ...Cartridge ma
injured.

1869. Oct. 1 ......Fireworks ir
killed.

1870. Dec. 9......Ludlow's C
ham;
girls; k

1871. May 17 ...Cartridge
more t

Dec. 31 ...Cartridge

1872. Jan. 18 ...Gladstone
injur

Mar. 40 ...Fuzee f
girls

1873. Nov. 4......Firewor
—a

1878. Feb. 12....Detona
Da

1878. Dec. 23....Afgha
4
e
b

1879. April 19...Roy

1880. May 1......An

1880. Sept.

As early

of London passed an ordinance containing llowing:—

ri. Item.—That no person whatever be henceforth ed, at any time, to make or cause to be made any firework, or to fire or cause to be fired any such , within the City or Liberties thereof, except usously as shall be thereunto appointed by H. M., ful authority under him."

r ordinance on the same subject was pro- in 1697.

—by 38 and 39 Vict., cap. 17—regulations cted regarding firework manufactories and under this Act prohibitive measures taken. The manufacture can no longer on in densely populated districts.

FLOURING MILLS.

ten years ago, it would have seemed quite lace to introduce such a title amongst the f explosion; not that such may not have then ed, but because science had not then recog- their possibility. It was, indeed, known st was inflammable, and highly so, but as y stated, not that it was explosive. It was ientific investigation which followed the g of the Tradeston Mills, near Glasgow, in at first determined the explosive properties n-flour under certain conditions. I have no of ascertaining the number of flour mills in ted Kingdom, but they can probably be l by thousands. In Hungary, in 1872, re 20,691 water, and 482 steam flour-mills 21,176; in the United States, in 1879, re about 24,000 flouring mills. Anything the safety of these may therefore be with interest.

proceed to furnish a brief list of the ls which, in the light of 1872, may be re- s having been destroyed by "explosion":—

LE G.—EXPLOSIONS IN FLOURING-MILLS.

......The "Stow Mills" at Masconta, Illinois. They were grinding "middlings," i.e., flour of the middle quality, as distinguished from the finer or coarser samples. About three o'clock in the morning, the miller in charge went up to the chamber (a large box extending through several storeys), as he had often done before, "to jar the middlings down"—they having clogged. He carried a small oil-lamp, which he placed on a beam just behind and above his head. He then opened a slide, and thrust in a shovel, which started the flour down with a thump, raising a cloud of dust, when instantly, as if it had been coal-gas, it flashed, burning the miller's hair and beard, and filled the box with a sheet of flame, which spread with great rapidity, and burned the mill.

This incident drew attention to the circumstances attending the burning of a flour-mill at Dover, Kentucky, several years before. Here the floor of the flour-box gave way with the weight of a man, great dust was created, which, the instant it reached the furnace in the boiler-room, to which it was naturally drawn down, ignited with an explosive flash, and burned the mill.

80 .. Schmidt & Co.'s Mill, St. Louis. The light, or globe-lamp, was held near a bran spout, extending the height of the mill. The dust ignited with a flash, and burned the mill.

......Bertchey's Mill, Milwaukee. The fire originated in a candle being held near a feed-spout reaching through the mill. The ignition was instantaneous—several parts of the mill appearing to be on fire at the same moment.

......Tradeston Mills and Granaries, near Glasgow. Explosion, followed by fire. The circumstances seemed inexplicable, and the fire offices interested instructed Mr. W. J. Macquorn Rankine, C.E., LL.D., F.R.S., and Mr. Stevenson Macadam, Ph.D., F.R.S.E., to investigate and report. The following embodies the substantial result of this inquiry:—

" . . . We have made a searching investigation into all the circumstances connected with this disastrous affair, and having inspected the premises, examined all surviving witnesses, visited various other mills, and inquired, by the examination of witnesses and documents, into the list of other fires and explosions of a like nature, we have to report as follows:—

"1. That the primary cause of the fire and explosion was the accidental stoppage of the feed of one pair of stones engaged in the grinding of sharps, which led to the stones becoming highly heated and striking fire. 2. That the fire thus generated inflamed the finely divided dust which was diffused through the air in the exhaust-conduits, and then passed on to the exhaust-box. 3. That the sudden combustion of the dust diffused through the air would produce a very high temperature in the gaseous products of that combustion, and this would necessarily be accompanied by a great and sudden increase of pressure and bulk—constituting, in fact, an explosion. 4. That the first effects of this explosion would be to burst the exhaust-box, and allow of the diffusion of the dust and flame through the atmosphere of the whole mill. 5. That this communication of inflammable dust and flame throughout the atmosphere of the whole mill was the cause of the second explosion, by which the gable walls were blown out, the mill reduced to ruins, and the wood-work set on fire. 6. That the stores or granaries were set fire to partly by the flame and fire from the mill travelling along the gangways, and partly from the burning materials falling through the skylights. 7. That no explosive or other foreign material was used in the manufacture of the flour, and that we found the steam-boilers uninjured. 8. That we have not been able to trace blame on the part of the proprietors of the mill, or of any one in their employment, as every precaution known at the time was used."

Passing from the particular to the general, they say:—

"We have ascertained, both from the evidence of eye-witnesses, and from printed and published documents, that fire-explosions, similar in their cause and nature to that at Tradeston Mills, are accidents of ordinary occurrence in flour-mills, especially since the introduction of the apparatus called the 'exhaust.' This fact, however, is little known to the general public, or indeed to any one except those practically employed in working such mills, though it appears to be better known on the Continent than in Great Britain, being mentioned in French and German treatises on flour-mills, but not to our knowledge in the standard English books on that subject. . . . . It requires some consideration to see the reason why such fire-explosions are not much more frequent than they have been."

1878. May 2......Washburn Mills, Minneapolis, probably the largest flouring mills in the world (containing 41 run of stones), and 5 neighbouring mills—6 in all. The building wherein the explosion occurred contained two independent mills under one roof, and was 7½ stories high, grinding from 1½ to 2 million bushels of wheat per year. The night hands had just come when, at 7.20 p.m., the explosion occurred; the whole building was levelled with the ground, and the entire city suffered a shock as from an earthquake, nearly all the windows being broken, and large stones thrown into the air descended through their roofs. The conflagration of the ruins extended the fire to much other property, so that the entire loss was estimated at near upon £200,000.

Many theories were again started, as that the Minnesota wheat contained more sulphur than that from any other State; but the facts brought to light in the "Tradeston" investigation afforded an entire solution.

NOTE.—Mr. John B. Kehl, proprietor of the Glen Flouring Mills, Chipewa Falls, Wisconsin, has since forwarded an account of a small explosion which he personally witnessed in his own mill.

Science has here stepped in and afforded the required relief. By means of powerful magnets fixed in the hoppers, particles of iron which formerly got mixed with the grain from the wire binding of the sheaves are now intercepted; particles of dirt are otherwise disposed of; and by means of gauze wire screens the dust is kept from contact with the artificial lights employed.

GAS (COAL.)

The use of coal-gas for illuminating and domestic purposes took its rise early in the present century. It is impossible to estimate the precise degree of danger to life and property which have resulted. Hundreds of gas explosions occur every year; but many of these are very slight, and the fire insurance offices cover the damage done to property insured. It has sometimes been suggested that science should devise a means of making coal-gas less offensive to the sense of smell. It is well that this has never been done, or the danger from its use would have been ten times increased. Seeing that the manufacture of gas for the purposes of our great towns is frequently carried on in thickly populated neighbourhoods, it is fortunate that no great catastrophe has occurred. I mark a few of the more prominent explosions:—

TABLE H.—GAS EXPLOSIONS OF SERIOUS MAGNITUDE.

1841. Dec. 16	...Gasholder at Dundee Gas-works; 2 persons killed, and much property in the neighbourhood damaged.
1853. Jan. ?	...The new gasholder at Chatham.
1858. Sept. 13	...Explosion at Sheffield Music-hall; 4 persons killed in endeavouring to escape from hall.
1865. Oct. 31	...Gasholder at works of London Gas Company, Nine Elms; 10 workmen killed, and great destruction of property.
1876. Aug.	...On board ship *Atalanta*, Cardiff. The ship was loaded with 1,400 tons of steam coal, and the hatches were kept down; gas accumulated, and coming into contact with a lighted match, struck by the second mate, exploded, killing 4 men, and greatly damaging the ship. A Board of Trade inquiry was instituted. (See result at end of table.)
1878. Mar. 8	......Gasoline Gas Machine exploded in Town-hall, Harrison, Ohio; much damage.
June 6	...On board steamer, *Chrysolite*, in the Alexandra Dock, Newport (Monmouthshire); 4 killed and 7 wounded; side of ship blown out.
June 29	...At Cardiff, on board *Caduceus*, a steamer, loading with 2,300 tons of steam coal, for Aden. 6 men were loading, when one lowered a light that the others might see better, and explosion resulted.
Oct. 11	...Extensive explosion at Linesey Cotton Mill, Blackburn; a great number of the work-people injured, and stock of cotton fired.
1879. Jan. 6	......Three, more or less, serious gas explosions in different parts of London.
April 14	...At Vigo, on board the British steamer, *Streonshath*, from Newport, for Savona, laden with coals.
May 20	...At Cardiff, on board Genoese brig, *Santina Ansaldo*, laden with small coal for Leghorn.
June 6	......At Sittingbourne Gas Works, doing considerable damage. It occurred in the "Governor-house," and was attributed to failure of apparatus.
1880. Jan. 3	......At Plymouth, in a circus; considerable destruction.
April	......An experimental military balloon, at Meudon (France); attributed to the effect of the high external temperature on the gas in the balloon.
April 13	...At St. Martin's Church, Bradley, near Wolverhampton; organ destroyed, stained glass windows broken, and fabric partly destroyed.
July 5	......Tottenham-court-road, London; capacious newly-laid gas mains, filled by leakage from old mains, exploded, causing considerable damage to persons and property, tearing up the road, and continuing to explode every few hundred yards along Bayley-street, Rathbone-place, and Charlotte-street.
1880. July 13	...At Bilston (Staffordshire), an streets, the sewers having gas; followed by a second explosion. The road torn dreds of yards.
Aug. 9	......Remarkable explosi n of a Ludgate-hill, the flame ex pipes towards the main; was arrested at an early sta
1881. Feb. 3	......At Sheffield; great damage drapery establishment.

It is seen from the preceding table to shipping engaged in the carrying is very considerable. After the exp *Atalanta*, in 1876, a Board of Trad held, and a report issued, the conclu was as follows:—

"The Court is of opinion that a cargo description, so especially liable to gener be ventilated by tubes fore and aft r underside of the deck, but not exten surface of the cargo, and having suff above the deck to be out of the reach of revolving cowls so as to create a thoro air fore and aft above the cargo, by wl accumulating gas would be continuousl And in no case should a vessel loade allowed to proceed to sea depending u only for ventilation."

GUNPOWDER.

This explosive compound has now for something over five c its influence upon the destinies of been very considerable—perhaps those resulting from any other sin save the printing-press. Its direct war against the human race, and i even to a greater degree than co foreseen. Here I have only to re light of its accidental, and not of i destructiveness; and so regarded, degree of minor importance. Yet the immediate subject of explosio still a prominent place.

The City of London, in its Fire 1667, enacted as follows:—

"xxvii. *Item.*—That no gunpowder the walls of the City (except as afores secure places as shall be allowed and Court of Aldermen."

The exception related to the st powder to be ready for the blowin ings in case of fire, the Great Fire c been so stayed. That it was freque in this manner at subsequent fires ground for believing. The poet "Trivia, or the Art of Walking written in 1715, makes pointed re practice, which, while the houses we of wood, no doubt had advantages.

"Hark! the drum thunders; far, ye cr
Behold the ready match is tipt with fire
The nitrous store is laid; the smutty tr
With running blaze, awakes the barrell
Flames sudden wrap the walls; with su
The shattered pile sinks on the smoky g

That gunpowder is capable of b for useful purposes, is truly a set-off a evils it has produced. In its app purposes of blasting in metal and co led to many disasters. But in re

ring works, such as the removal of the -down Cliff at Dover, 19th September, 1850; moval of a dangerous portion of the Undercliff, Wight, a few years later; its more recent opening for navigation, Hell-gate, East New York—where another great operation, said, is still pending—it has been of real. Yet, on the other side—that of wanton ction of property—there is a sadly dark l; as witness a table given in a later portion is paper, "Wilful Damage."

I.—EXPLOSIONS OF GUNPOWDER FROM EARLIEST DOWN TO PRESENT TIME IN VARIOUS PARTS THE WORLD; CAUSE BEING STATED WHERE PRAC-

...Gunpowder magazine at Londonderry; great damage.
...Venice—fire at the arsenal; explosion followed, reducing city to ruins.
...Magazine at Gravelines; about 3,000 people killed.
...At Dublin, 218 barrels exploded, killing about 100 men.
7 ...Athlone, Ireland, great storm; lightning struck castle, and exploded powder magazine.
10...At Bremen, by which about 1,000 houses were destroyed, and 40 persons killed.
...France—some mules employed to carry gunpowder to Niort, stopping near Pilori, in Poictiers, and being incommoded by flies, stamped upon a pavement of some flints, and thus ignited some grains which had dropped from the bags they were carrying. A terrific explosion followed, not only destroying the mules and their drivers, but throwing down houses, and committing other devastation.
} Three serious explosions at the Hounslow Mills.
1 ...The city of Worcester was greatly damaged by a gunpowder explosion.
...Goree nearly destroyed.
.....Two mills blown up at Waltham.
.....The Royal Mills at Faversham blown up.
3...Italy—powder magazine at Crema; the town ignited.
...An explosion at Ewell Mills destroyed property valued at £8,000.
3 ...Powder magazine at Brescia, caused by lightning; about 3,000 deaths.
...About the same date a magazine at Venice, by lightning; 400 killed.
...Faversham Powder Mills.
7 ...Hounslow Powder Mills.
8 ...At Moulsey; 3 men killed.
.....Three mills blown up at Hounslow.
...At Chester, destroyed many spectators at a puppet-show, and greatly damaged many houses.
...At Chamberry; 18 persons killed, and several houses destroyed.
...Abbeville nearly destroyed; 150 inhabitants perished, 100 houses destroyed.
...Trichinopoli blown up; 300 inhabitants lost their lives, 340,000 ball cartridges were destroyed, and the whole foundations shaken.
4...At Hounslow; 2 persons killed.
0 ...At Picardy.
8 ...Epsom Mills were blown up.
5 ...Vienna received great damage, and several lives were lost.
...Civita Vecchia nearly destroyed.
9 ...Malaga gunpowder magazine; lightning.
...Sumatra gunpowder magazine; lightning.
0...Benwolen magazine and laboratory; lightning.
...Tangiers gunpowder magazine; lightning.
1 ...A magazine destroyed by fire at Corfu; 72,000 lbs. of powder and 600 bombshells blew up; 180 men killed.
.....Faversham Powder Mills.
...Dartford Mills; 6 men killed; great destruction of property.
.....Ewell Powder Mills.
5...At Lubin, in Poland, the axle-tree of a carriage conveying powder to the army took fire, and destroyed a great number of houses and some public buildings; about 90 persons were killed and wounded.
...At Bayonne, the chapel at the new castle was blown up, and 100 lives destroyed.
...The barracks at Youghall blown up.

1794. Sept. 3 ...Powder mills at Grenelle, near Paris, exploded; near 3,000 persons lost their lives, and all adjacent buildings were destroyed.
Dec. 20 ...Landau had its arsenal blown up.
Dec. 31 ...Dartford Mills; 11 men killed.
1796. Jan. 14 ...Hounslow Mills; 3 men killed; great destruction of property.
Aug. 10 ...At Dartford; 4 persons killed.
1798. May 20 ...Battle Mills; 3 killed, and great destruction of property.
1799. Jan. 14 ...At Dartford; 3 persons killed.
July 13 ...At a mill on Twickenham-common; 4 men killed.
1800. May 28 ...A powder magazine at Nantes blew up, destroying many persons and houses.
1801. Mar. 20 ...Battle Mills; 1 man killed.
1801. April 25 ...Waltham Mills; 9 men killed.
1802. Sept. 8 ...Faversham Mills; 6 men and 3 horses killed.
1805. June 15 ...At Dartford; 2 men killed.
Oct. 1 ......Powder mill, Roslin, near Edinburgh; 2 killed.
1807. Jan. ....A vessel lying in the Rapenburg Canal, Leyden, blew up, and destroyed the best-built portion of this interesting city.
June 26 ...Powder magazine at Luxemburg; lightning.
Sept. 18 ...Faversham Mills; 6 men and 3 horses killed.
1808. Sept. 9......Powder magazine at Venice; lighting.
1810. Jan. 16 ...Faversham Mills; 5 men, a boy, and some horses killed.
Sept. 2......Eisenbach; 3 French powder wagons blown up; 54 lives and escort, with 28 houses destroyed.
Sept. 24 ...Dartford Mills; 2 men killed.
1811. Nov. 27 ...The Walthham Mills blown up; 7 men killed.
1812. July 4......At Hounslow; 2 men wounded.
July 14 ...Roslin Mills, near Edinburgh, blown up; 2 men killed.
1813. Aug. 21 ...Two explosions at Hounslow Mills; 3 workmen killed.
1814. Sept. ......Battle Mills; 3 men killed.
1816. April 16 ...Toulouse Powder Mills; 16 killed, others wounded.
1817. Oct. 3 ......Faversham Mills; 3 men killed.
1818. Mar. 19 ...Powder Mills at Brandy-Wine, U.S.; 30 killed, many wounded.
1829. Nov. 28 ...Powder magazine at Navarino; lightning.
1837. Aug. 23 ...Powder-laden lighter off East Greenwich, causing considerable damage to persons and property.
1838. Oct. 8 ......Hall's mills, Faversham; 4 persons killed.
1840. June 6......Powder magazine at Bombay; lightning.
...Also, about same date, Dum Dum.
1843. April 13 ...Waltham Mills; 7 men killed, and buildings destroyed.
April 22 ...Powder magazine at Puzzaloni, Sicily; lightning.
April 23 ...Powder magazine at Gaucin, Spain; lightning.
1845. March 8 ...Algiers; two magazines, killing 43 workmen, 10 artillerymen, and 31 pontonniers.
1850. Mar. 11 ...Three explosions at Hounslow Mills; 8 persons killed.
Sept. 29 ...The *Donna Maria*, Portuguese frigate, blown up at Macao, when firing a salute in honour of the Prince Consort; 200 men and boys reported to have perished.
Oct. 18 ...The *Abdul Medjid*, Turkish line of battle ship, blown up in Bosphorous; about 500 killed.
May 1 ......Fleet of powder-laden boats at Benares, causing death of 420 persons on the spot, and injuring over 800 others.
1851. April 3 ...Powder magazine at Temesvar, Hungary.
...At Hounslow Mills; lightning.
1853. Aug. 17 ...Powder magazine at Gibraltar; 5 men killed, 1 injured.
1855. Nov. 6......Powder magazine, Rhodes; lightning; 300 lives, and 400 houses destroyed.
Nov. 15 ...French magazine at the Crimea, containing large quantities of munitions of attack; which also exploded English magazine; 53 killed and many hundreds wounded.
1856. Mar. 7......Hatton Powder Mills, Hounslow; 3 lives lost; caused by sparks from lamp.
Nov. 6......Powder magazine at Rhodes; lightning.
1857. Aug. 10 ...Powder magazine at Joudpore, Bombay; lightning; 1,000 killed.
1859. Mar. 30 ...Hounslow Mills blew up; loss of 7 lives.
Aug. 6......Ballincolig Mills, near Cork, blew up; 5 persons killed. (See 1861.)
1860. Sept. 10...Melford Powder Works, Argyleshire; 6 men killed; 3 tons of powder.
Dec. 1......In shop at Norwich; 2 persons killed, and much property destroyed.
1861. May 27 ...Waltham Mills blew up; 1 killed, and many others wounded.
Oct. 24 ...Powder mills, Ballincolig, Cork; 5 persons killed.
1862. Sept. 9 ...Nancy Kuke Powder Mills, Cornwall; 6 women killed.
1864. Jan. 9......The *Lottie Sleigh* exploded in the Mersey, at Liverpool, in consequence of fire on vessel, caused by oil cans igniting; great damage to property.
Oct. 1 ......At Erith, Messrs. Hall's magazine, 100,000 lbs. of powder; 10 men killed, and property damaged for many miles round.

1864. Dec. 9......Powder store at Buenos Ayres exploded, killing 160 soldiers.
Dec. 24 ...A powder vessel exploded at Wilmington, U.S., without other damage.
1865. Mar. 29 ...Faversham Mills; 2 persons injured.
April 11 ...Four or five barrels of powder exploded in a shop in Southwark.
May 24 ...At Mobile, U.S.; about 300 persons killed.
Sept. 25...Ewell Mills; 2 men killed.
1867. Dec. 28 ...Faversham Mills; 11 men killed, and much damage done; shock felt at Canterbury, 10 miles off.
1868. Dec. 21 ...Another at Faversham Mills; 5 killed, 4 injured.
1869. June 19 ...Hounslow Powder Mills; 4 persons killed.
Oct. 19 ...Black Beck Mills, Windermere; 3 persons killed.
Dec. 17 ...Hounslow Mills; 3 persons killed.
1870. Mar. 11 ...Kaimes' Powder Mill, Rothesay; 5 workmen killed, and serious injury to buildings.
1871. Feb. 5......Powder wagon on railway between Bardoz and St. Nazaire; 60 persons killed, and about 100 others injured.
Feb. 6......Dunkirk Powder Magazine; about 60 lives lost; caused by careless use of lucifer matches.
Mar. 2 ...Powder arsenal, Morges; 20 soldiers killed.
1872. Feb. 5......Hall's Powder Works, Faversham; 2 killed, 2 injured.
May 23 ...Roslin Powder Mills, near Edinburgh; several killed.
May 30 ...Powder magazine, Porthywain Lime Rocks, near Oswestry; 6 killed.
Sept. 6 ...Hounslow Mills; 3 lives lost.
1874. Jan. 7......Carthagena powder magazine.
Oct. 2......The barge *Tilbury*, on the Regent's-canal, laden with 4 tons of blasting powder and 6 barrels of petroleum. The latter, it was believed, ignited, and fired the powder. Exploded near North-lodge, Regent's-park, killing 3 persons, and doing vast damage to property.
Nov. 3 ...Hounslow Mills; 4 killed, 2 injured.
1875. July 16 ...Hounslow Mills; considerable destruction of property; no lives lost.
Aug. 17 ...At Barcelona, the Spanish steamer *Express* was loading with war material, and exploded; 50 lives lost.
1876. April 22...In a railway tunnel at Cymner, near Heath; 13 excavators killed.
July 1 ......Hounslow Mills; workmen had left premises.
1877. May 6......Powder mill at Schulau, near Blankenese (Hamburg); effects very violent; 20 killed, and much property destroyed.
July 12 ...Powder manufactory at Okta, near St. Petersburg; 6 killed, and many wounded; fire followed, and much damage was done to property.
July 30 ...Floating magazine on Thames; 3 killed.
Oct. 6 ......Powder factory at Térguschoff, Plojesti, Austria, with immense stores; 16 killed and many wounded.
1878. March 31..At Marsh Works Powder Factory; "green charge."
Nov. 29 ...Powder mill, Elterwater, near Ambleside, Westmoreland; 3 killed, 1 injured. [I quote from official report hereon in note below.]
1879. Feb. 10 ...Chilworth Mills, near Guildford; 2 killed.
Feb. 21 ...Messrs. Hill's Mills, Faversham; 1 killed, and immense destruction of property.
March 1 ...At Dalry, Ayrshire; powder for mining purposes.
1880. Jan 3.......On a gunsmith's premises, at Doncaster.
April 7.....Halton Mills, Hounslow; no lives, but considerable damage.
May 8......At Rothweil Powder Factory, Geesthacht, near Hamburg; 4 killed.
At Worsborough Powder Mills, near Barnsley; men not allowed in mill while machinery at work; considerable destruction of property.
Dec. 11.....At Marsh Mills, Faversham; in the testing-house, which was closed; shock very violent.
1881. Mar. 19....At Blackbeck Powder Mills, High Furness; 2 loud explosions; 3 killed.

NOTE.—The report of Major Ford, R.A., one of H.M.'s Inspectors of Explosives, on the Elterwater explosion, 29th Nov., 1878, contained the following passage:—"One lesson, at any rate, may be learnt from this accident—namely, that active supervision in matters of detail of foremen in gunpowder factories cannot be dispensed with. Such a system as was found to be in force at this factory ought to be impossible. . . . Better supervision on the part of the manager would have insured the observance of the special rule, which was, as it appears, habitually disregarded. It also appears that, where access can be obtained to a factory during the absence of the men, it would certainly be advisable not to leave the keys of the powder buildings where anyone who has been employed about the place can obtain them. Lastly, the great value of trees as a screen to powder buildings is again forcibly illustrated. Large pieces of burning wood are very likely to be caught by tall trees, and even a small branch is sometimes sufficient to stop tiles and slates."

The annual value of gunpowder exported from this country as an article of comme £300,000.

It is seen that a considerable numb plosions enumerated in this table we lightning. I do not think it must from this fact that powder magazines particular or peculiar attractions to fluid, although it may be thought tha compounds there collected may dc lieve the real fact to be that the siti powder mills affords an entire sol problem. They are mostly located o near rivers, where there are few builc electric fluid may be attracted by moist towards their localities. Ice-houses a lightning in a like manner, and fro the same cause; but on this point] some difference of opinion. It cannot that there is any other resemblance be mills and ice houses.

METAL MINES.

The metal mines of this country from the coal mines) suffer very fire-damp, and explosions conseque In the 18 years, 1861-78, there ha 54 deaths from this cause in thes 1 in Derbyshire district, 2 in the Yorl 2 in Monmouthshire district, 18 in N shire, Cheshire, and Shropshire, Staffordshire and Worcestershire, : Scotland district, and 11 in West Sco

MINERAL OILS.

Another important element in of explosions during the presen arises in the use of mineral oils, chi and its products. This oil came use on account of its comparat after its discovery, in 1859-61, in C the coal regions of Pennsylvania. state it is inflammable at a very low and much mischief has resulted in There is now a Petroleum Associatio the quality for the purposes of c public safety. The individual catast counted by the hundred, and even by but the larger ones traceable to expl numerous; and yet probably nearly conflagrations laid to its charge hav nated in explosions.

TABLE J.—SERIOUS EXPLOSIONS RESULTIN OILS.

1868. Dec. 13 ...Three Bridges Railway Station killed.
1869. Oct. 28 .. Bordeaux Harbour; 16 vesse many others injured.
1871. July 16 ...Manufactory, near Rheims; al
Oct. 4 ..... Chelsea.—Triple explosion at oi Manor-street, King's-road.
Oct. 16.....Erith.—The brigantine *Ruth* barrels of petroleum, 100 o
1874. Oct. 2 ......Regent's Canal.—The explosio board the *Tilbury* was beli occasioned by the vapour petroleum on board. (See
1878. July ...Petroleum factory at Lyons; 3
1880. June 4 ....Terrific conflagration caused Titusville, Penn; $20,000 b destroyed, and large portio

NOTE.—Many great conflagrations have oc tanks at "Petrolia" and elsewhere, from the inf acting upon the vapour.

keeping of petroleum is now regulated Parliament, enacted in 1862, 1868, and ctively. The supply of the oil has se indications of falling off in the ates, but new sources of supply are in Bohemia and elsewhere.

STEAM BOILERS.

come to notice the explosions of lers. The gradual but now general n of steam into our locomotive appli- into our manufacturing operations, e present century, I have already Boilers may be divided into four es:—1. Marine; 2. Manufacturing; tive; 4. Domestic. And in each in- y need to be managed by those who l their construction and requirements. majority of casualties—and these have past, if they are not now, of alarming -arise from ignorance or negligence. ideavoured to frame an estimate of the steam boilers of each class in use in this t hitherto without success. The num- is a very large aggregate. The evidence the Select Parliamentary Committee, uire into the causes of boiler explosions tion of the labours of a like committee n 1870) pointed to a belief that there ss than 100,000 steam boilers—exclu- e of locomotive engines, steamships, c and hot-house boilers—in the United that date. An estimate I had pre- confirmed this view.

HE MORE SERIOUS EXPLOSIONS OF STEAM THE VARIOUS CLASSES DURING THE PRESENT :—

.Marine boiler on board the *Victoria*, of Hull, on experimental trip from London to the Nore; 3 killed.
.Machine works of Messrs. Elice, Manchester; 6 killed and many injured; also much property destroyed.
.*Telegraph*, high-pressure steamer, at Helensburgh pier, N.B.
.Bolckow's Iron Works, Middlesboro; 4 killed, and 20 injured.
Mr. Samuda's Works, Blackwall; 3 killed outright, and many wounded, some of whom subsequently died.
.*Cricket* steam-boat, at Hungerford-bridge; 6 killed, and 12 seriously injured.
.Lambert Bottom Mills, Preston; 7 killed.
.Printing-office, Hogue-street, New York, causing destruction of entire building—six storeys; 30 killed.
.*Red Rover*, at Bristol; 6 passengers killed, and nearly all on board injured.
.French war-ship *Valmy*, blown up in Torbay; 20 killed.
.*Plover*, exploded while getting up steam in Glasgow Harbour.
.Marsland's Cotton Factory, Stockport; 20 killed.
.Steam tug at Conham Ferry, near Bristol.
.*Times*, screw steamer, Dublin Harbour; 12 killed, 10 of whom were passengers.
.Williamson's Calico Factory, Rochdale; 10 killed. Inexperienced persons getting up steam.
.Walker's Ironworks, Newcastle; 6 killed and many injured.
.Upper Apsley Mill, Huddersfield; 8 killed, and many injured.
Black Eagle steam-tug, in Cardiff Dock; 5 killed
.Edwards's Spinning Mills, Dundee; 19 killed. and 14 injured. Building destroyed.
.Portable steam-engine, at Lewes Agricultural Show; 5 killed and many injured.
... *Towning* in Yarmouth Roads; 11 killed, and great loss of live stock, forming cargo.
.Portable threshing machine in Langton (Yorks); 2 killed and 6 injured.

1862. April 15...Millfield Ironworks, Priestfield, Staffordshire; 28 killed and 10 injured. Three-fourths of the boiler, weighing about 8 tons, was thrown from to 200 to 300 feet in the air, and in falling caused great destruction of property.
Nov. 8......Locomotive engine, "Perseus," in engine shed of Great Western Railway; 2 killed, and much damage.
Dec. 3......Midland Ironworks, Masboro' (Yorks); 9 killed, and many injured.
1863. March 8...Moss End Ironworks, near Glasgow; great destruction of life and property.
1864. Feb. 17 ...Aberaman Ironworks, South Wales, 13 killed, many injured.
1865. June 7......Brewery in Burton; 2 killed, 5 injured.
1867. Dec. 29 ...The Greek war steamer, *Bubulino*, blown to pieces; some killed, and many injured.
1868. Sept. 27 ...Moxley Steel and Ironworks, Wolverhampton; 11 killed, and many injured.
Oct. 2 ......Elsecar Ironworks, Newcastle; several killed.
1869. Feb. 21.....Austrian frigate, *Radetzky*, blown up off Lima; 380 killed.
June 9 .....Bingley, near Bradford, boiler in manufacturing premises; killing 9 children at play on ground adjoining the works.
Aug. 11....Steam-tug, off Custom-house Quay, Thames; 3 killed.
14....Steamer *Cumberland*, Ohio River; 20 killed.
Oct. .....Bramley's Iron Foundry, Accrington; 5 killed.
Nov. 3......The *Thistle*, at Sheerness; 10 killed.
Dec. 2......A screw steam-lighter; all on board killed.
3......Britannia Iron Works, Wloverhampton; 8 killed.
1870. April 20...Locomotive at Warrington; 5 killed.
May 26.....Cleugh-hall Iron Works, Staffordshire; 4 killed and 9 injured.
1872. April 11...Steamer *Oceanus*, on Mississippi; 6 killed.
1873. Nov. 22....Cameron's Engineering Works, Glasgow; 4 killed.
1874. Mar. 2......Alderman Thompson's Spinning Mills, Blackburn; 12 killed; 20 injured.
1876. Mar. 28....Locomotive in ballast train, between Kilmarnoch and Irvine; 4 killed, 9 injured.
July 14....On board H.M. iron-clad turret-ship *Thunderer*, one of the boilers; 38 killed, and many seriously injured.
1878. April 8....On board steamer *Orion*, in River Schelde; 1 killed.
27...Messrs. Strong's Ironworks, Dublin; 16 killed.
1879. Mar. 19....Harthill pit, Linlithgowshire; 6 boilers said to have exploded simultaneously; 3 killed, with great destruction of property; chimney shaft, 100 ft. high, knocked down.
May 13.....Walsall District Iron Works; 5 killed and some wounded.
June 29....Steamer *Black Swan*, in Yarmouth Roads.
Oct. 6......Messrs. Balm and Pritchards, Halifax; 6 killed.
1880. Jan. 27.....On board steam-ship *Jones Brothers*, of Newport, at Bilbao; 3 killed.
Mar. .....Glasgow Iron Works; 25 killed, and many injured.
May 15.....Birchill's-hall Iron Works, Walsall; 25 killed, and many seriously injured.
29.....Boiler at Gunpowder Factory, Wetteren, near Ghent; 7 killed.
June 6 ...Vivian Copper Works, Swansea; one of the men blown into a tank of molten metal.
July 20 ...On board the *St. Oswin*, at Gibraltar; 3 killed.
Oct. 27 ...Balfron Iron Works, near Dunfermline; 1 killed.
Nov. 20 ...New British Iron Company's Works, Acrefail, near Ruabon; 4 killed.
1881. Jan. 19....Providence Mill, near Batley (Yorks.); 11 killed.

A noticeable feature in the foregoing table—which must be regarded as illustrative only—is the large proportion of boilers which have exploded at iron-works. One of two things seems certain, either that inferior boilers are too often used on such works, unequal to the pressure required, or that the jarring of the rolling-mill or the steam-hammer produces mischief to the boilers or their setting, and so deteriorates them more rapidly than elsewhere.

With regard to marine boilers, happily an explosion of these is now an increasingly rare occurrence. The very idea of such a catastrophe at sea is terrible to contemplate. The Board of Trade regulations as to inspection and working have been most efficacious.

As to the boilers employed in our great manu-

facturing industries, the advent of the Steam Boiler Inspection Association (in 1855*), and still more that of the Steam Boiler Insurance Companies, the first of which was that founded in Manchester in 1858, with Mr. R. B. Longridge as its chief engineer. When I made the calculations upon which the rates of this company were based, I hardly foresaw to the full extent the benefit which would result, from periodical inspection, in the way of prevention of accidents. By the end of the year 1860 the company had received proposals for the insurance of 3,149 boilers. Other boiler insurance companies followed, notably the Midland Company at Wolverhampton (in 1862), with Mr. E. Binden Marten as its chief engineer. In collecting the data for the calculation of rates and estimation of risks, in connection with this company, I obtained a considerable insight into the boilers in use in the Staffordshire iron districts, and certainly formed an unfavourable opinion of many of these.

By the end of 1868 the number of boilers under protection of the different boiler insurance companies was found to be as follows: —

1. Boiler Insurance and Steam Power Company (1858)	10,900
2. Midland Steam Boiler Protection and Assurance Company (1862)	2,600
3. Association for Prevention of Steam Boiler Explosions (Manchester, 1855-64)	1,900
4. Nation Boiler Insurance Company, Limited (1864)	2,000
Total..................	17,400

An estimate was then made that in the United Kingdom during the preceding ten years there had been 495 boiler explosions, by which 786 persons had lost their lives, and a yet greater number had sustained serious injuries. The annual explosions were estimated at 50, causing 80 deaths. Out of 16,411 boilers insured by the Boiler Insurance Company only 15 had exploded, being less than one per 1,000. The number of inspections made by the officers of the above insurance company in 1868 was 65,440, showing an average of nearly four inspections per boiler per annum.

The value of periodical inspection of boilers cannot be over-rated; and the practice has been largely extended by the insurance companies. The inspectors of the Boiler Company (Manchester), made, in 1878, no less than 79,423 inspections, of which 67,208 were ordinary examinations; 1,215 were internal examinations; and 11,000 were thorough examinations—the last two involving stoppage of the works for the purpose. And their value is at once seen in the return of the various defects reported to the owners of the boilers examined, as follows:—

Corrosion of plates and angle iron	1,825
Fracture of plates and angle iron	443
Safety-valves out of order, or over-loaded	1,896
Pressure gauges out of order..........	744
Water gauges out of order, or fixed too low	360
Boilers damaged from over-heating, owing to accumulation of deposit	21
Boilers damaged in consequence of deficiency of water	
Total	

* On 31st December, 1855, this association had 269 members owning 990 boilers; at the close of 1859, 538 owners, with 1,619 boilers; but immediately on the formation of the insurance company *the business of this* association fell off. In 1864 the association added *on the business of insurance.* A similar inspection association had been founded at Huddersfield in 1858.

—all trivial defects being omitted from thi ration.

While no complete returns have hereto kept of boiler explosions, the insurance c engaged in the business have kept re such explosions over a series of years; and admittedly incomplete, they are still intere even valuable, as far as they go. The Table, going back more than half a centu boiler insurance was commenced, has b piled by Mr. E. B. Marten, and kindly my disposal, with many other facts— which I cannot now use—for the purpos present paper.

Table L.—Showing approximately the N Steam-boiler Explosions in the United and the Loss of Life and Injury during the period 1800—80.

Year.	No.	Killed.	Injured.	Tot
Unknown	1	0	0	
1800—1809	1	3	5	
1810—1814	5	10	3	
1815—1820	7	42	33	
1821—1825	3	8	0	
1826	1	0	16	
1827	5	19	0	
1828	2	0	0	
1829	2	1	5	
1830	3	15	57	
1831	3	8	10	
1832	7	14	11	
1833	0	0	0	
1834	0	0	0	
1835	3	1	0	
1836	3	10	8	
1837	2	1	0	
1838	16	24	30	
1839	5	4	2	
1840	3	4	6	
1841	7	10	33	
1842	8	40	23	
1843	12	0	24	
1844	8	22	6	
1845	18	36	100	
1846	11	25	26	
1847	17	19	64	
1848	9	41	23	
1849	11	12	33	
1850	13	31	42	
1851	14	58	23	
1852	10	17	17	
1853	18	35	95	
1854	15	36	34	
1855	35	38	55	
1856	33	66	105	
1857	37	80	57	
1858	34	50	89	
1859	39	75	71	
1860	35	78	82	
1861	30	46	42	
1862	36	91	69	
1863	51	79	78	
1864	51	67	116	
1865	58	50	92	
1866	70	85	160	
1867	48	70	88	
1868	45	57	71	
1869	59	87	128	
1870	70	85	138	
1871	66	66	113	
1872	74	50	137	
1873	88	66	94	
1874	76	77	198	
1875	68	81	142	
1876	39	93	110	
1877	44	54	75	
1878	46	47	84	
1879	30	38	53	
1880	31	71	83	
	1,536	2,293	3,259	

tuations in the annual number of ex- e somewhat considerable, but this may the imperfection of the records; yet it ave been more influenced by the state of ast in the last two decades. This is very striking degree in a comparison of 866-7; and in a less striking degree in npared with later years.

ber of boilers insured, and, therefore, ection, in the United Kingdom, is be from 40,000 to 50,000. The actual explosions during the last 19 years, as Mr. Marten, up to end of 1880, is 1,047 average of just over 55 per annum; and, m worse, giving a mortality of killed, ed, 2,026—total, 3,350. Of the property the explosions, no record seems to have but taking the boilers as being of the 100 each at the time of the explosion— rtainly an under-estimate—we have an of £104,700, and this is not including etting" and fittings, to say nothing of by stoppage of works. Assuming that loss all round is £500 in respect to each sion, we thus have an annual loss of say nothing of the loss of life; but I st we shall be told to-night that this n under-estimate.

arles Longridge, of the Engine-boiler vers' Liability Insurance Company , has kindly sent me the following which, from a mechanical point of much interest, and some value:—

WING THE NUMBERS OF DIFFERENT KINDS WHICH HAVE EXPLODED DURING THE LAST AND THE CAUSES OF THE EXPLOSIONS, JNDER THE FOLLOWING HEADS, VIZ.:—

d design, workmanship, or material.
efects arising in course of use.
norance or carelessness of attendants.
uses extraneous or not ascertained.

LER.	A.	B.	C.	X.	Total.	Per-centages.
cashire..	124	115	112	6	357	34·1
....	106	62	67	7	242	23·1
Agri-	32	44	31	16	123	11·7
....	16	26	21	8	71	6·8
ne.........	10	8	25	2	45	4·3
&c.......	19	9	16	—	44	4·2
....	4	1	37	—	42	4·1
rs, &c....	17	1	9	8	35	3·3
....	10	9	14	1	34	3·2
nomisers	9	2	10	5	26	2·5
....	—	—	—	28	28	2·7
....	347	277	342	81	1,047	
f Causes	33·14	26·47	32·66	7·73		

ONGRIDGE.—The above particulars are summarised of Explosions published by Mr. E. B. Marten, of

ases, the actual cause of the explosion isfactorily ascertained. But another practical interest may be applied, viz., of the works wherein the exploded employed. I will take two years by ple:—

1864.

Works.	No. of Explosions.	No. of Killed.
	Boilers.	Lives.
Iron works and foundries	9	32
Coal and other mines	9	11
Locomotive	6	4
Agricultural engine	1	1
Steamboat	2	7
Corn mill	2	6
Saw mill	2	1
Flax mill	1	1
Silk mill	1	1
Bleachworks	1	7
Chemical works	1	0
Cement works, flint mill, brickyard	3	0
House	3	3
Boilers for other purposes	2	0
	43	74

1878.

Iron works	9	20
Collieries and mines	8	10
Steam vessels	7	7
Kitchens	7	2
Railways (Locomotive?)	4	0
Farms	3	1
Cotton mills	2	0
Flour mills	2	0
Flax mill	1	4
Woollen mill	1	3
Saw mill	1	1
Distillery	1	1
Paper mill	1	0
Waterworks	1	0
Chemical works	1	0
Brick works	1	0
Stone quarry	1	0
Picture frame works	1	0
	52	49

Iron works and mines in both years assert a most unsatisfactory monopoly. Steam vessels and locomotives are high, as also domestic or kitchen boilers. In 1864 there were no cotton mill boilers, in 1878 two.

In the matter of locomotive engines, great care in the construction and working have rendered explosions of very rare occurrence.

Domestic boilers in kitchen ranges are mostly under the control of those who have no mechanical knowledge, and too often but very limited powers of observation, and casualties are, therefore, to be expected. Mr. Samuel B. Goslin (a member of this Society) has published a useful little tract, "A Review of the Facts and Records in connection with Kitchen Boiler Explosions and Hot-water Boiler Explosions of 1881, with some Remarks upon their Prevention, and the Remedies."

There have been, from time to time, projects put forward for a Government inspection of steam boilers. This I conceive to be quite unnecessary, except in the case of marine boilers. The insurance companies do the work far more effectively and economically than it can be accomplished by any Government department. But in this connection, I may say I am glad to see before Parliament notice of a measure introduced by Mr. Hugh Mason, for enforcing better provisions regarding inquiries into cases of actual explosion. This is much needed. His Bill provides that, on the occurrence of an explo-

sion, notice of the various circumstances attending it should be sent within 24 hours to the Board of Trade by the owner or user. The maximum penalty for not complying with this direction is fixed at £20. The Board of Trade is thereupon authorised to appoint an engineer to make a preliminary inquiry; then, if it be deemed expedient, to have a formal investigation held by a Court consisting of two practical engineers and one competent lawyer, for the purposes of its investigations, the Court would have the powers of a Court of Summary Jurisdiction. Those who conduct these preliminary inquiries or formal investigations, are directed to report on the causes of the explosion and the circumstances attending it; and these reports are to be published by the Board. The Bill excludes from the scope of its operations all boilers used exclusively for domestic purposes, and those used in her Majesty's service, or on board steamships having certificates from the Board of Trade.

Boiler Insurance in United States.

In the United States, much attention is being paid to the subject of steam boiler explosions. Mr. J. M. Allen, the able president of the Hartford Steam Boiler Inspection and Insurance Company (established 1866), has founded, in the interest of that company, a publication, called the *Locomotive*, wherein all that relates to the subject is freely and fully discussed, and records of explosions are published. From its columns is prepared the following, otherwise almost incredible figures:—

Classification of Explosions which have been published in the "Locomotive" as having occurred between October 1, 1867, and January 1, 1880.

Kind of Works.	Number of Boilers Exploded.	Number of Persons Killed.	Number of Persons Injured.
1. Saw, planing, and wood-working mills ...	281	497	570
2. Steamboats, tugs, yachts, and steam barges	186	956	816
3. Railroad locomotives	185	249	238
4. Iron-works, furnaces, foundries, and machine shops	92	147	324
5. Paper, flouring, and grist mills, bleacheries, and print-works	92	96	122
6. Portable hoisting, threshing, and pile-drivers	66	143	137
7. Cotton, woollen, flax, and other fabric mills	55	72	131
8. Mines, quarries, oil-mills, and refineries...	44	73	76
9. Heating and domestic boilers	29	10	33
10. Chemical, rendering, and slaughtering works	27	43	32
11. Distilleries, breweries, and sugar refineries	25	19	34
Miscellaneous—52 kinds not specified above...	217	201	93
	1,299	2,506	2,612

In 1864, an Act was passed in the Pennsylvania Legislature, authorising the Mayor of Philadelphia to appoint a proper officer to inspect the steam-boilers in that city, without whose certificate no steam-engine or boiler should be put into use, with full power to enter upon premises, and order removal of buildings necessary for effective inspection. The deaths from explosions in the United States, during the year 1870, w as being 290.

Wilful Damage.—Diabolical Ex

An examination of my records show are, unfortunately, sufficient of the Class," *i.e.*, wilful damage to life or justify a special tabular enumeration. sary to state here, as in the other tabl enumeration is not to be regarded a complete. It does not seem that t explosion has originated in the pre century, but its recent development rapid and daring.

Table M.—Explosions Wilfully Cause Damage Life or Property

1645.	"When the Swedish fleet, whic up in winter quarters at W paring to leave that port i 1645, certain ambiguous Pomeranian, called Hans Gr so much under suspicion th searched, and in it were f packed with all sorts of expl mable materials, in the mi been concealed clockwork 12 hours after being set go an explosion. Greff stated that certain persons in Lüb to place these boxes, one in A ship, the other in that comma Lieutenant Blom—but he c names, and stringent inves discover these or any accor accordingly burnt alive. machines placed in the Ar were to be seen as late as 17 10th Jan., 1876.
1800. Dec. 24	...The first Napoleon's life att infernal machine.
1835. July 28	...Attempt by Fieschi upon the life by an infernal machine, fire the lines of the National Gu vard du Temple. The mac 25 barrels, charged with var lighted simultaneously by powder. The king and his about 40 persons were killed of high rank, and many wo
1842. Nov. 14	...Davison's Scythe-grinding Wo blown up with gunpowder strike.
1858. Jan. 14	...Attempted assassination of Na Opera, by the throwing of 3 killed, and many wounded. brought home to Orsini, Pie and others.
1867. Dec. 13	...Attempt to blow up prison at Cle outrage; 6 persons killed ou 120 more on less seriously much property destroyed.
1875. Dec. 11	...At Bremerhaven, a man, named signed a cask of dynamite, New York, by North Germ *Mosel*. With it he enclo machine, which would in 8 a blow powerful enough to mite, and, as a consequence From some cause the case dock, killing over 80, and 200 persons, chiefly intendin confessed his crime, and ceived it only for the sake sum for which the case committed suicide.
1876. May 4	...A man, named Everett, attemp store of Messrs. Baldwin an by placing an infernal m stair-way. The machine co box, filled with bottles of k powder, with a lighted can centre. The porter discov The object was here, also, thousand dollars in respec he had consigned to Baldw days' previously, and insur
1879. March	...At Cracow; the explosion of of the police-office.

...Blowing up of Winter Palace in St. Petersburg; many killed and injured; much property damaged.

...In the Casino, at Monte Carlo, a tin box, filled with gunpowder, had been placed under a large clock, which was exploded with a slow match; many injured.

...Explosive packages were placed on the main line of London and North-Western Railway, near Bushey, in view, it was supposed, of wrecking the Irish mail.

...Explosive substance introduced into coal supply of engine attached to night mail to Liverpool and Manchester; much damage done to engine, but the train escaped destruction.

..."At a ball at Schwarzenburg, Saxony, a young man entered, having what appeared to be a cigar in his mouth. He went to the chandelier as if to light it, and a terrible explosion ensued. The lights were extinguished, the walls partly gave way, dancers of both sexes were covered with blood, and the young man was blown to pieces. He had resolved on committing suicide, and had adopted a dynamite cartridge for that purpose."—*Times*, Dec 9, 1880.

..Explosion at Marsh Powder Mills, Faversham, caused wilfully; £500 reward offered.

..The Emperor of Russia assassinated in St. Petersburg, by means of Orsini bombs:—"A French sailing vessel, the *Coralie*, which has put in at Dunkirk to revictual, left Pampeluna on New Year's-eve, with a cargo of Orsini bombs, destined for St. Petersburg. Stress of weather obliged her to take refuge at Bordeaux, and on her continuing the voyage, several of the bombs exploded, killing three of the crew. After a month's detention at Havre, the authorities allowed her to proceed, being satisfied that there was no further danger, but on reaching Dunkirk, the captain learned what had happened at St. Petersburg, whereupon he reported to the Russian Consul the nature of his cargo, and has suspended his voyage pending an investigation."—*Times*, March 21, 1881.

Attempt to blow up the Egyptian-hall of Mansion House, London, with gunpowder.

ıachines have long been used in warirst introduced by an Italian engineer, siege of Antwerp, 1584-5.

ONCLUDING OBSERVATIONS.

ct—which, I believe, has not been eated of as a whole—has grown upon This paper can still only be regarded for further inquiry and observation. ɜrs' Liability Act, 1880, will force the ı of the great risks arising from boiler ıore fully upon employers than herel, in truth, there need be small pity ho shall be found defaulters in this ɜ means of safety are ready at hand. ɜe companies have their agencies in the kingdom. A proposal to insure, ures inspection, and hence almost ›very of defects. Insurance here, as ɜr cases, affords nearly all the remedy ake it, that no insurance association, ; an employer under the provisions of ›uld think of entering upon a risk mployer had not insured his boiler. be, *prima facie*, an act of negligence. ıde an effort to estimate the annual perty resulting from explosions of ı in this country; but the data availgether insufficient for the purpose. ife is very sad, but can be approxigh the aid of the returns with which ly dealt. I do not believe those reɾet complete.

ınexion with colliery explosions, perɪe greatest loss is sustained. In 1865, there were as many as 3,268 collieries in the United Kingdom, employing 307,542 miners, who produced 98,150,587 tons of coal, valued at the pit's mouth at £24,537,646. In 1873, the number of collieries had increased to 3,527, and all the other figures in a like degree. There is now a much larger number at work. In one of the most dangerous districts of the kingdom, there had occurred, in 16 years, accidents by explosion, costing £56,914; these ranged from £200 to £25,000 each. This—supposing all collieries to be equally fiery, which is happily not the case—would give £910,624 as the loss sustained throughout the United Kingdom in 16 years, being £28,457 per annum. The total value of 3,180 collieries at another period was estimated at £70,000,000, giving an average of £22,000 per colliery; hence, the rate of premium to be paid for insurance against colliery explosions might be nearly calculated; but there are other difficulties in the way. Besides, we are not here to discuss insurance, except in so far as it may aid in the reduction of the number of accidents. In some Continential countries, as, for instance, Austria, insurance against explosions of all kinds is very general. I think it may, with advantage, be made so here.

In furnishing the details herein contained, my object has been the prevention, *i.e.*, the lessening the number of explosions of all kinds. The details of the occurrences and their causes are designed as a means to this end. To know the cause of an evil is sometimes regarded as half the remedy. I sincerely trust it may prove so in this instance. Science may, in this matter, help forward the cause of humanity. I look to those now present, or who may read this paper in the *Journal* of the Society, to do their share in the following up the considerations I have raised, and in throwing light upon points which I may have overlooked.

NOTE.—I have not attempted on this occasion to deal with those great convulsions of nature—physical explosions—usually designated earthquakes. I am treating of these in connection with my inquiry into plagues and pestilences. It will be observed that I have almost in every instance, given the month and day of the explosions here recorded. This is done very much in view of meteorological investigation hereafter.

DISCUSSION.

Mr. Christopher Cooke said he remembered an explosion at a firework manufactory, in the Westminster-bridge-road, by which several lives were lost. Explosions of gas he thought were generally due to ignorance and carelessness, through people going to look for an escape of gas with a lighted candle. He believed the researches of Scott and Galloway showed that there was a connection between the atmospheric pressure and explosions in coal mines.

Mr. Longridge said he was only specially interested in one out of the many cases of explosions which had been treated of, viz., boilers, and he had come rather to listen than to speak, hoping to get some further statistics on the subject, as he knew that Mr. Walford had a great faculty for obtaining and utilising information of that character. He had been more occupied with the inspection of boilers than inquiring into the causes of explosion, but he quite agreed with Mr. Walford that most of these explosions could be prevented by efficient inspection. He

was, however, opposed to compulsory inspection, because it would be a great obstacle to progress. They saw what had been done in the way of compulsory inspection of factories, mines, and steamers, and he did not think the results were sufficiently encouraging to warrant extending the system. The inspection of steam-boilers was being carried out at present by the insurance companies, and he thought compulsion would be a mistake. It would necessitate the setting up of a standard, to which every boiler must conform or be condemned, whilst it would be impossible to fix any standard which would be applicable to all boilers, working as they did under so many different conditions. Again, if you had compulsory inspection, you relieved the boiler owner from an immense amount of responsibility; he would be compelled to adopt the recommendations of the inspector, and would then claim to be relieved of that responsibility which every boiler owner ought to be under. The course proposed in Mr. Mason's Bill was far preferable; and he must say, from some experience, that the inquiries as at present conducted were almost ludicrous. The absurd questions put by the coroner, or by the lawyers, led to an immense waste of time; whereas, if there were a couple of men who understood the subject, the inquiry would be got through much quicker, and a more satisfactory result would be arrived at. Under the present system the almost invariable result was a verdict of accidental death, though in one or two cases there had been a verdict of manslaughter. In one case in Scotland, where a man was tried for manslaughter, the jury returned a verdict of "not proven." If they could get the causes determined, explosions might be prevented in future. They were generally said to be accidents, but in the majority of cases that was simply untrue.

Mr. Pfoundes said he had seen a little of the use of steam in the colonies and the East, both afloat and ashore, and on one occasion witnessed an explosion by which more persons were hurled into eternity than he saw at present before him, and many more were seriously injured. At that time he was organising a large steamship company on the coast of China and Japan, and, from his experience of what were commonly called the black squad, he only wondered there were not more accidents than there were. They were, he believed, in many cases, due to the gross carelessness, and even incompetence, of the men in charge of the boilers. He could not speak of the effect of steam hammers on boilers, but he could say, from personal experience, that boilers used in connection with stampers for crushing quartz, and brought close to the stampers, as they often were to avoid loss of steam, were seriously affected by the constant vibration. He would urge the necessity of encouraging a more intelligent class of young men to come forward, and make themselves competent to take charge of steam-boilers; and he did not think a little higher rate of pay would be a very heavy tax on the owners of steam machinery. In Yokohama and Jeddo he had seen many hundreds of men who applied for situations; but really steady, competent, sober men were in a lamentable minority.

Mr. F. J. Bramwell, F.R.S., said this most interesting paper touched on so many subjects that it was impossible to discuss it as a whole, but there were one or two matters alluded to which had come within his cognisance, and on which he might say a word or two. He had had a good deal to do with flour mills, and with the introduction of the blast and exhaust into English mills, which the late Mr. Rankine seemed to think responsible for the explosions from flour dust. Now he observed that both the great explosions in America and in Glasgow occurred when they were grinding, not wheat, but what was called in America and in England, middlings, and in Glasgow *was called sharps*. That meant regrinding a portion of *the meal which had* been taken out in the operation of dressing, and had to be further ground and re-dressed. The material arising from this re-grinding would be much drier than if it were the product of [illegible] wheat itself; indeed, in the United Kingdom [illegible] especially, when grinding home-grown wheat, [illegible] difficulty was, not to prevent the exhaust trunks [illegible] being too dry, but, on account of the evolution [illegible] moisture, to prevent their contents fermenting and [illegible] coming offensive. In the United States there w[illegible] greater chance of the conditions favourable to a[illegible] sion occurring, both because the wheat was drier, [illegible] because it was the habit, when he was there [illegible] years ago, to run the mills at a much greater rate [illegible] English millers could afford (afford because this [illegible] was accompanied by a bad yield), and the heat [illegible] generated would be much higher than when [illegible] grinding was carried on more slowly. It [illegible] be easily understood how, when there were [illegible] stances favouring the production of dry [illegible] which was diffused through the atmosphere, [illegible] very possible for an explosion to occur. The [illegible] cause of gas explosions was, no doubt, that [illegible] would go, as had been said, to look for an [illegible] lighted candle, which they generally held high [illegible] their heads; but after all, he did not think [illegible] been an additional source of danger. It was [illegible] tallow candles and whale oil did not explode, but [illegible] more accidents occurred from sparks falling from [illegible] snuffed candle, from candles falling out of candle[illegible] from lamps upsetting, and things of that kind, [illegible] arose from gas, the flame of which was [illegible] put in a position where it could do no harm. [illegible] respect to explosions of gas works themselves, [illegible] had been some few cases, but very few; and he [illegible] not agree that the presence of gas works in [illegible] of population was a source of danger. It [illegible] be found that the explosion of gas-holders had [illegible] occurred when they were in use, but when they [illegible] under repair, imperfectly emptied, and the air [illegible] suffered to enter them, and thus an explosive mixture was formed. He remembered one instance at P[illegible] where a gas-holder which was under repair had [illegible] been properly emptied, and a red-hot rivet being [illegible] in, the mixture exploded. He did not see that there [illegible] the slightest chance of an explosion while the manufacture was going on and the gas-holder was full. [illegible] Goswell-street station of the Chartered Company, [illegible] 15 years ago, a girder fell upon the gas-holder, [illegible] broke it, and a neighbouring flame set fire [illegible] gas, and the whole gas in the holder [illegible] right out without an explosion; it was [illegible] enormous gas bonfire. He was glad to find that [illegible] a steady decrease in the number of boiler explosions, which was doubly encouraging, as the number [illegible] must be largely on the increase. Reference had [illegible] made to the frequency of explosions in iron works, [illegible] it was suggested that this might arise from the [illegible] being jarred by the action of the machinery. He [illegible] much doubted if that were so, and such a cause [illegible] not needed to account for the frequency of explosions [illegible] these works, as there were other reasons which, [illegible] judgment, were quite sufficient. In iron works [illegible] often the waste heat from as many as four furnaces [illegible] directed against the outer shells of boilers of very [illegible] diameter, a construction adopted when the usual [illegible] sure of steam was about 5 or 6 lbs. to the inch, [illegible] struction that had been continued when the p[illegible] had risen to 40 or 50 lbs. The furnaces were [illegible] from various causes, not all working at the same [illegible] so that sometimes one portion of the boiler was [illegible] and sometimes another, and thus it was exposed [illegible] succession of injurious strains which did not [illegible] under ordinary circumstances of boiler use. [illegible] plates were not of the most ductile description, [illegible] strains gradually produced cracks, and the boiler [illegible] then it was calked, and the very act of calking [illegible] to its destruction, and, finally, it exploded. Th[illegible]

being situated in the centre of three or four furnaces, at each of which two men worked, and, generally speaking, close to other boilers and furnaces of similar construction, the result was generally very destructive; bricks were hurled in all directions, and much damage ensued. Of late years, however, the matter had been much better understood; and now it was usual for the heat from the furnace only to operate on the boiler, and the boiler, instead of being surrounded by brickwork, was placed overhead, and covered with a non-conducting material; the heat drew through one or two internal flues; it was fairly treated as regards expansion and contraction; it was in full view for inspection, and even if an explosion did occur, it was not likely to do so much harm. It had been proposed, as a preventive of explosions, that the use of waste heat from the furnaces should be discontinued, but having regard to the frightful competition there was by Belgian manufacturers, which resulted in a great many of the wrought-iron joists used in building now imported, instead of being made in England, it would be impossible for English manufacturers to hold their ground at all, if the great economy arising from the utilisation of this waste heat were thrown away. He must dissent from the approval which had been given to the Board of Trade regulations with regard to steamboats, which he believed had done a great deal of harm. We were fast getting into the condition which Mr. Longridge had pointed out would be the result of the introduction of compulsory inspection generally. If the Board of Trade regulations with regard to marine boilers were applied to locomotives, the result in round figures would be, that the pressure used in locomotive boilers, which very rarely exploded, would have to be reduced one half, and the result would be an enormous increase in the consumption of coal. He would here repeat what he said to the Boiler Explosion Committee in 1871, when an attempt was made to introduce legislation which would have been destructive to mechanical improvement in this country. He then referred to statistics which had been quoted to-night. In a paper read at the meeting of the Institution of Mechanical Engineers at Nottingham in 1870, it was stated that there were 55 explosions per annum, causing 80 deaths, of which, on the average, 13½ arose from the negligence of the attendant—which no inspection would have prevented—and 3½ from kitchen boilers. Thus there were 17 out of the 55 which inspection would not prevent, leaving 38 which might have been prevented by the most perfect inspection. It also appeared that when inspection took place, one boiler in [illegible] exploded (now, it appeared the proportion was one in [illegible]) as against one in 2,000 without inspection, so that inspection only saved 55 per cent. It therefore came to this, that inspection as then practised would have saved 46 lives out of 80. Taking the number of boilers, as nearly as could be ascertained, at [illegible]000, excluding railways, and making the best estimate possible of the consumption per horse-power, he showed that if anything were done which would increase the consumption (or would prevent a saving) of 1 lb. of coal per indicated horse-power per hour, it would involve the consumption of four million tons of coal per year. Now, looking at the returns of the inspectors of mines, taking one year with another, it appeared there were ten violent deaths for every million tons of coal raised. If, therefore, a measure were passed which would have the effect of stopping the improvement of boilers, and lead to a want of economy of 1 lb. of coal per horse-power per hour, you might save 46 lives by boilers not exploding; but you would not only be wasting coal, but would be wasting 40 lives in extracting it. As he pointed out to the committee, you might buy anything too dear, even human life, especially if you bought it with other human life. He was glad to find Mr. Walford came to the conclusion that obligatory inspection was not desirable, and Mr. Longridge had very forcibly pointed out some objections to it. However unnecessary the orders of the inspector, the owner would be practically compelled to obey them, and having done so, he would cease to be responsible. He might give an instance of how this would work. Many present were acquainted with the system of heating by hot water carried out by Mr. Perkins. Many years ago Mr. Perkins's father employed that mode for heating boilers; he applied the fire to hot-water pipes, which circulated within the boiler, and the boiler itself never saw the fire at all. A boiler thus constructed had been working 28 or 38 years (he forgot which) at the warehouse of a well-known furniture manufacturer in Tottenham-court-road. He had his boiler inspected by some boiler insurance company, and the order was given that the boiler ought to be discontinued, because it was so many years old. The question was put, "What is the matter with it?" and they could not find anything the matter with it, but still, it was so many years old. The owner felt compelled to have it replaced by a new one. He applied to Mr. Perkins for a new one of the same kind, when Mr. Perkins said there was no need to replace it, as there was nothing the matter with it; and, at any rate, before it was taken out, he should like to see if he could burst it. Accordingly, he (Mr. Bramwell) and several others went to see this boiler burst. It ordinarily worked at a pressure of about 50 lbs., and the pressure was got up to 200 lbs., when it leaked so much at all the seams, that it was impossible to get the pressure any higher. Yet this boiler had to be replaced on account of its age, when it was being safely worked at a pressure of one-fourth of that at which it leaked like a sieve, so that it would have been impossible to explode it. Another point which he brought before the committee, in connection with the economy of fuel, was this. In non-condensing engines especially, it was usual to turn the waste steam into the feed water so as to heat it, and thereby economise fuel, and this was very commonly done by simply blowing the waste steam into the water. This was forbidden by the engineer to a boiler insurance company, who said that it was liable to introduce grease into the water, and that this would act injuriously on the boiler. He pointed out to the committee of 1871 that if there were compulsory inspection, the great object of an inspector would be to say that there were no explosions in his district, and he would give orders which would ensure that result. Now the great bulk of the small engines in use throughout the country were of a very wasteful kind, being non-condensing engines, working at a comparatively low pressure, usually about 30 lbs. to 35 lbs. pressure above the atmosphere, a pressure which, being reduced by the throttle valve, would not show more than about 14 lbs. in the cylinder. Now the inspector going into a factory where 35 lbs. of steam was being used, would be very likely to say, I will allow you to use the boiler, if you reduce the pressure 10 lbs., which the owner would probably agree to, rather than go to the expense of a new boiler, and the result would be the consumption of so many tons extra of coal per year. He had been very much pleased with the lucid statement of Mr. Longridge, whose prejudices certainly, if he had any, must have been in favour of inspection. No doubt it was very undesirable that anybody should be killed by avoidable accidents; and when explosions did occur, they were very startling and horrible; but before doing anything which would interfere with the progress of engineering improvement, on which the prosperity of the country depended, it would be well to stop the unnecessary loss of life in other directions. At the present time, the deaths from street accidents in London alone were from five to seven a week, or three or four times the number which were caused by boiler explosions throughout the whole country, and he thought attention should be given to such matters as these before anything was done which would interfere with mechanical improvements or with economy in fuel.

Mr. Gosling suggested that if a system of insuring

domestic boilers were instituted, many persons would take advantage of it, for many persons to whom he had spoken on the subject had expressed their desire to have their boilers inspected. He found that in many cases they had been in use for many years without being inspected. He often found, especially in country boilers, that the persons in charge of steam-boilers were lamentably ignorant and incompetent. One of the most important things to be looked to was to get a better class of men to attend to boilers.

The Chairman said there was so much matter in the paper that it was very difficult to deal with it except in the way of general approval, and some points on which he should have liked to touch, he hardly felt free to deal with. The question of accidents in mines was now in the hands of a Royal Commission, of which he was a member, which was carefully investigating the subject, and he hoped some fruitful results might ensue. He might point out, however, that the accidents in coal mines due to explosions, formidable as they were, bore but a small proportion to the accidents due to other causes, by which one or two lives only at a time were sacrificed. It would be a mistake to introduce anything like over-legislation in connection with any branch of the subject; and it should be borne in mind, as Mr. Bramwell had justly observed, that there were other important sources of casualties which equally required to be dealt with. Many accidents ascribed to explosions were not due to explosions at all, especially those in connection with petroleum. As had been said, explosions did occasionally occur in manufactories or stores of petroleum, but the accidents with petroleum were generally due to spilling, or overturning of lamps, not to an explosion in the lamps themselves. Again, in the case of chemical explosions, which embraced a large variety of accidents, many would hardly come properly under the description frequently given of them. In some instances they might be due to spontaneous action occurring amongst substances mingled or brought together, or they might be due to the secondary action of fire, which caused an explosion. In the case of the Gateshead explosion, although it was chiefly attributed to the action of steam, there were all the elements of a gigantic explosion of gunpowder present. There was an enormous store of nitrate of soda, which was only another name for saltpetre, besides large stores of sulphur, and of charcoal or carbonaceous matter, and although the explosion might be due to large volumes of water meeting with highly heated matter, yet those materials meeting in a highly heated state might develop suddenly large volumes of gas under high pressure, and thus contribute to the violent explosive effects produced. With regard to explosions due to dust, on which Mr. Bramwell had given interesting information, he had lately had occasion to look into this subject, and regretted that time and other circumstances did not admit of his giving the results of numerous experiments he had made in connection with the influence of dust on explosions in coal mines; but there was no doubt it was much greater than they had been disposed at one time to believe; and that serious and fearful as was the effect of fire-damp, in many instances coal-dust itself played a part quite as serious, if not more so. He concluded by proposing a vote of thanks to Mr. Walford.

The vote of thanks having been carried unanimously,

Mr. Walford briefly acknowledged the compliment, and said he trusted that the subject would, from time to time, receive that attention and elucidation which it deserved on the score of humanity. He thought there was a real reason why marine boilers should be placed under more stringent regulations than land boilers: as a ship at sea, in the event of a boiler explosion, presented a case of real disaster.

MISCELLANEOUS.

SANITATION AT THE GOVERNMENT O

Mr. Gorst asked in the House of Commons, day, 21st inst., for information respecting the alterations about to be made in the public off reply

Lord F. Cavendish said that nothing was so as to say how much works of this nature would c War-office was in a satisfactory condition, bu almost the only public office that was so.

Sir R. Cross said that he had found when h the Home-office that he suffered much from headaches. The clerks refused to go to the ne on account of their unsatisfactory condition, himself had almost resolved to take lodgings neighbourhood and charge the Treasury with t They could find no plan of the drains, and t were made in Whitehall-place before the juncti the main drains could be found, and then th discovered 2 ft. of sewage matter. It was a m must be thoroughly investigated, and remedie hazards and all costs. Unfortunately, it wa sible to say what the cost would be.

Lord John Manners said that it was absolute sary that these sanitary improvements should l out without delay. When the new great public were undertaken, the highest engineering skill employed to insure that the sanitary arrangem properly carried out.

Lord F. Cavendish said that, with the ex the War-office, nearly all the public offices, lik of the other houses in the neighbourhood of ' were in an unsatisfactory condition. They, proposed a substantial vote, and intended to l the worst of those offices, the Home-office. system of drainage was bad, but the fault c with the architects. He might mention that of Works had laid down certain simple regu prevent the recurrence of the evil.

COPYRIGHT.

The Committee of the Jurisprudence Depa the Social Science Association have been enga preparation of a series of twenty-one heads, they deal with the whole question of copyri following is an abstract of the heads which posed to incorporate in a Bill hereafter to b before Parliament:—

1. That registration of copyright in wo classes published in the United Kingdom dramatic or musical works first performed in t Kingdom though not published (but not in drawings, or sculpture, since there is nothing analagous to publication), should be compulso

2. That if owners of copyrights in paintin ings, or sculpture, should desire to register t rights, for the purpose of evidencing thei otherwise, they should have power to do so.

3. That it is desirable that registration effected at a Government office, to be establ maintained for that purpose.

4. That in the case of books, photographs, en prints, or similar works, copyright should exclusive right of multiplying copies of the tected.

5. That the term of copyright should be from the date of registration.

6. That in the case of paintings, drawings, ture, copyright should mean the exclusive righ plying copies of the design of the work protec

7. That in the case of paintings, drawings,

: term of copyright should be the life of the d thirty years after his death.
at on the sale of a painting, drawing, or piece ture, or when such work is executed on com- . the copyright in it should remain with; the the absence of a written agreement to the con- That the purchaser or other owner of a paint- drawing should be protected against replicas.
at the present law by which, in the case of in magazines, reviews, or other collective except encyclopœdias, written and paid for on that the copyright shall belong to the pro- of the collective work, a right of separate tion reverts to the author after twenty-eight should be modified, three years being substituted ty-eight.
at the present law as to presentation of books British Museum and other libraries should altered.
at in the case of British subjects copyright Act to be passed should extend to all the minions.
at aliens, wherever resident, should be entitled ht in paintings, drawings, and sculpture, if their works into the British dominions in etain or sell them there; and to copyright in l other classes.
a British author, who first publishes his of the British dominions, or whose play or nposition is first performed out of those should not be prevented thereby from opyright in those dominions by subsequent or performance therein.
14, 15, relate to the power of search which d to confer; 16, 17, to the colonial question, 20, 21, to copyright in foreign books and

ect of artistic copyright is one in which the Arts has long been interested. In 1858, a was appointed by the Society, with the late Eastlake, President of the Royal Academy, , to consider the subject, and the ultimate eir labours was "an Act for amending the to Copyright in works of the Fine Arts, essing fraud in the production and sale of ," which was passed in 1862.
act of Lord John Manners' Copyright Bill, ated in the *Journal*, vol. 27, p. 879.

NOTES ON BOOKS.

al Buildings: their construction, heating, ittings, &c., with remarks on some of the s involved, and their application. By F. es. London: B. T. Batsford.

tor points out that while much is written s, flowers, and fruits, it is somewhat difficult information respecting the proper construc- rangements of buildings required for the cul- those plants, flowers, and fruits. He, there- imself to produce a volume in which an ould find just those constructional and points which are required by the horticul- in which a gardener could find details s province with which he should be ac- The various questions relating to growing- w-houses, garden-frames, subsidiary build- the materials used in them, besides the used for heating, ventilation, and water all dealt with in this volume, which contains llustrations.

of Great Britain: a Text-Book of Agricul- pted to the syllabus of the Science and Art Department, South Kensington. By Hugh Clements, with an introduction by H. Kains-Jackson. London: Crosby Lockwood & Co., 1881.

This little book is a reprint of a series of articles contributed to the *Farmer*, and is intended by the author to form a text-book for the use of teachers and students of agricultural classes connected with the Science and Art Department, the elementary and advanced stages being dealt with as a whole. The chief subjects treated of in the different chapters are, soils, irrigation and drainage, farm buildings and implements, crops, constituents of food, stock, &c.

Andrea Sansovino und seine Schule. Für Künstler und Kunstfreunde, von Dr. Paul Schönfeld. Stuttgart; verlag der J. B. Metzler'schen Buchhandlung, 1881.

Dr. Schönfeld has here given a study of the works of Andrea Sansovino, the great sculptor and architect of the Italian Renaissance, and of those of the school which he formed around him, including Jacopo Sansovino, Alfonso Lombardo, Niccolo de' Pericoli, Francesco da Sangallo, Lionardo del Tasso, and other famous sculptors. In illustration of the essay there are added thirty permanent photographic plates of the chief works of these artists.

GENERAL NOTES.

Gas-lighted Buoys.—Compressed gas for the illumination of buoys, according to the *Times*, is gradually coming into use. Ordinary coal-gas is not employed, but an oil-gas, manufactured upon Pintsch's system, which has been adopted by several railway companies for carriage lighting. The gas is produced by distilling the refuse of shale oil, the gaseous products being stored and used under pressure. The buoy is made of wrought iron, and is itself the receiver of the compressed gas for use. A lamp is mounted on the top, which will burn for six, nine, or twelve weeks with one filling, according to the capacity of the buoy. The Trinity House has had two of these buoys under trial, their performances having been reported on as satisfactory. One of these buoys was placed on the East Oaze station, about one and three-quarter miles from the Mouse lightship, on the 18th of last April, and remained at its station until the 28th of January, when it was run into and damaged by a passing vessel. The Trinity House officials report that, during the period named, the light was burning without intermission, although it is stated by the officer in charge of the Mouse light-vessel that, in bad weather, the buoy was at times hidden from view by the spray. The Clyde Lighthouse Trustees have also taken the matter up, and are building gasworks at Port Glasgow, on Pintsch's system, for the service of gas-lighted buoys on the Clyde. One of these buoys has been burning on the Roseneath Patch for some time past, being supplied with gas from London, and a second is about to be delivered by Pintsch's Lighting Company for use on the Clyde. Another of these buoys is about to be despatched by the company to Port Said for use on the Suez Canal. It is seven feet in diameter, and will contain a sufficient supply of gas under pressure to give a light day and night for six weeks. The light burnt will be a red one, and the gas will be stored at a pressure of seven atmospheres, or 105 lbs. per square inch. The estimated cost of the gas is only 2½d. for twenty-four hours' consumption. The process of filling these buoys can be carried out in a few minutes. The reservoir of gas under pressure is floated alongside them in a tender, and the gas is passed from the reservoir into the buoy by means of a flexible tube.

Beaumont Compressed Air-Engine. — It should have been stated that the blocks of the illustrations of the "Beaumont Compressed Air-Engine," and the "Experimental Engine," in the last number of the *Journal* (p. 386), were kindly lent by the proprietors of the *Graphic* newspaper.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at eight o'clock:—

March 30.—"Recent Advances in Electric Lighting." By W. H. Preece., M.Inst.C.E. C. W. Siemens, LL.D., F.R.S., will preside.

April 6.—"The Discrimination and Artistic Use of Precious Stones." By Professor A. H. Church, F.C.S. Sir Philip Cunliffe-Owen, K.C.M.G., C.B., C.I.E.. will preside.

April 27.—"Five Years' Experience of the Working of the Trade Marks' Registration Acts." By Edmund Johnson.

May 4.—"Buying and Selling; its Nature and its Tools." By Professor Bonamy Price, M.A. Lord Alfred S. Churchill will preside.

Dates not yet fixed:—

"The Manufacture of Glass for Decorative Purposes." By H. J. Powell (Whitefriars Glass Works).

"The Electrical Railway, and the Transmission of Power by Electricity." By Alexander Siemens.

Foreign and Colonial Section.

Tuesday evenings, at eight o'clock:—

April 5.—"Canada; the Old Colony and the New Dominion." By E. Hepple Hall. John Rae, M.D., F.R.S., will preside.

May 10.—"Trade Relations between Great Britain and her Dependencies." By William Westgarth.

Applied Chemistry and Physics Section.

Thursday evenings, at eight o'clock:—

May 12.—"Recent Progress in the Manufacture and Applications of Steel." By Professor A. K. Huntington.

May 26.—"Telegraphic Photography." By Shelford Bidwell. Prof. W. G. Adams, F.R.S., will preside.

Indian Section.

Friday evenings, at eight o'clock:—

March 25.—"The Tenure and Cultivation of Land in India." By Sir George Campbell, K.C.S.I., M.P. Andrew Cassels, Member of Council, will preside.

May 13.—"Burmah." By General Sir Arthur Phayre, G.C.M.G., K.C.S.I., C.B.

Members are requested to notice that it may be necessary to make alterations in the dates of the above papers.

Cantor Lectures.

Monday evenings, at eight o'clock:—

The Third Course is on "The Scientific Principles involved in Electric Lighting," by Prof. W. G. Adams, F.R.S. Four Lectures.

Lecture IV.—March 28.

Subdivisions of the electric current. Incandescent lamps. Luminous effects of electric currents in a vacuum, and in various gases.

The Fourth Course will be on "The Art of Lace-making," by Alan S. Cole. Four Lectures.

Syllabus of the Course.

Lecture I.—April 4.

Introduction. Early forms of twisted, plaited, and looped threads. Ornamental borders of Assyrian, Greek, Roman, and other costumes. Sumptuary laws. Venetian books of patterns for embroidery and lace. Flanders a centre of linen trade of Europe. Spanish and French importations of early lace. Effect of production of machine-made lace upon production of hand-made lace.

Lecture II.—April 11.

Needlework upon a material. Needlew rate threads. Venetian needle-point l point and tape lace. French needle-poin centres. English and Flemish needle-poi

Lecture III.—May 2.

Fringes. Twisted thread-work in E 15th century. Early designs for plaite threads. Italian, Flemish, French, and l lace. Laces of primitive design.

Lecture IV.—May 9.

Resumé as to styles of design in ha Traditional patterns. Sketch of the d inventions for knitting and weaving thre lace. Differences between machines an laces. Modern hand-made laces at Bu Honiton, &c.

This course will be illustrated by speci Diagrams and photographs enlarged will means of the lantern and oxyhydrogen li

The Fifth Course will be on "Colo and its Influence upon Various In R. Brudenell Carter, F.R.C.S. Th May 16, 23, 30.

MEETINGS FOR THE ENSUING

Monday, March 28th...SOCIETY OF AR Adelphi, W.C., 8 p.m. (Cantor Lectu G. Adams, "The Scientific Princi Electric Lighting." (Lecture IV.)
Royal Geographical, University of Lon gardens, W., 8½ p.m. Mr. J. B. M Bolivia and the Gran Chaco."
British Architects, 9, Conduit-street, J. J. Stevenson, "Historical Docume
Institute of Actuaries, The Quadrangl W.C., 7 p.m. Mr. Cornelius Walfor of the Insurance Press in Relation to and Insurance Interests."
Medical, 11, Chandos-street, W., 8½ p.m

Tuesday, March 29th....Royal Institution, Alb 3 p.m. Prof. E. A. Schäfer, "The Bloo
Civil Engineers, 25, Great George-stre S.W., 8 p.m. Discussion on Mr. Davi "The Comparative Endurance of Iro when exposed to Corrosive Influences.
Royal Colonial, Grosvenor Gallery Li Bond-street, W., 8 p.m. Discussion Paper on "Imperial and Colonia Emigration," will be resumed.

Wednesday, March 30th...SOCIETY OF A Adelphi, W.C., 8 p.m. Mr. W. H. Advances in Electric Lighting."
Royal Botanic, Inner-circle, Regent's-p Exhibition of Spring Flowers.
Chemical, Burlington-house, W., 8 p.m.
Royal College of Physicians, Pall-m (Croonian Lectures.) Dr. Moxon, " Circulation upon the Nervous System

Thursday, March 31st...Royal, Burlington-ho
Antiquaries, Burlington-house, W., 8½
Royal Institution, Albemarle-street, W., Statham, "Ornament Historically a sidered." (Lecture III.)
Civil and Mechanical Engineers, 7, West S.W., 7 p.m. Mr. G. J. Child, "Lift &c."

Friday, April 1st...Royal College of Physician S.W., 5 p.m. (Lumleian Lectures "Bright's Disease." (Lecture I.)
Royal United Service Institution, Whit Captain Walter H. James, "On th Adapting the Existing Military Forc ments of the Empire."
Royal Institution, Albemarle-street, W Meeting. 9 p.m., Sir Henry S. Mai his Relation to Early Civil Justice."
Geologists' Association, University Coll

Saturday, April 2nd ... Ladies' Sanitary A House of the Society of Arts), S Richardson, "Domestic Sanitation or (Lecture VII.)
Royal Institution, Albemarle-street, W. R. Haweis, "American Humorists." (

L OF THE SOCIETY OF ARTS.

No. 1,480. Vol. XXIX.

FRIDAY, APRIL 1, 1881.

...ications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

CANTOR LECTURES.

...urth and concluding lecture of the third ...s delivered on Monday, 28th of March, ...sor W. G. Adams, F.R.S., on "The Principles involved in Electric Light-... he special subjects treated of in this ...re the subdivisions of the electric current, ...nt lamps, &c. The Joel, Werdermann, lamps, which were lent by the inventors, ...bited in action. The Swan lamps were ...y a Bürgin machine, lent by Mr. Cromp-... ...ramme machine was also lent by the ...ectric Company. The motive power, as ...lecture, was provided by a Robey engine. ...of thanks to the lecturer was proposed ...airman (Mr. F. J. Bramwell, F.R.S.), ...d unanimously.

ALBERT MEDAL.

...ncil will proceed to consider the award ...ert Medal for 1881, early in May next. ...l was struck to reward "distinguished ...romoting Arts, Manufactures, or Com-... ...d has been awarded as follows:—

... to Sir Rowland Hill, K.C.B., F.R.S., "for ...service to Arts, Manufactures, and Com-... ...he creation of the penny postage, and for ...forms in the postal system of this country, ... of which have, however, not been confined ...ntry, but have extended over the civilised ...

...o his Imperial Majesty, Napoleon III., "for ...d merit in promoting, in many ways, by his ...ertions, the international progress of Arts, ...es, and Commerce, the proofs of which are his judicious patronage of Art, his enlight-... ...rcial policy, and especially, by the abolition ...s in favour of British subjects."

... to Professor Faraday, D.C.L., F.R.S., for ...s in electricity, magnetism, and chemistry, ...eir relation to the industries of the world, ...gely promoted Arts, Manufactures, and ...

...to Mr. (afterwards Sir) W. Fothergill Cooke ...or (afterwards Sir) Charles Wheatstone, ...recognition of their joint labours in estab-... ...first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For. Memb. R.S., Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. (now Sir) Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. (now Sir) Henry Bessemer, F.R.S., "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Michel Eugène Chevreul, For. Memb. R.S., "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to C. W. Siemens, D.C.L., F.R.S., "for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvement in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to the Manufactures and the Arts."

In 1875, to Michel Chevalier, "the distinguished French statesman, who, by his writings and persistent exertions, extending over many years, has rendered essential service in promoting Arts, Manufactures, and Commerce."

In 1876, to Sir George B. Airy, K.C.B., F.R.S., Astronomer Royal, "for eminent services rendered to Commerce by his researches in nautical astronomy, and in magnetism, and by his improvements in the application of the mariner's compass to the navigation of iron ships."

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., member of the Institute of France, "the distinguished chemist, whose researches have exercised a very material influence on the advancement of the Industrial Arts."

In 1878, to Sir Wm. G. Armstrong, C.B., D.C.L., F.R.S., "because of his distinction as an engineer and as a scientific man, and because by the development of the transmission of power—hydraulically—due to his constant efforts, extending over many years, the manufactures of this country have been greatly aided, and mechanical power beneficially substituted for most laborious and injurious manual labour."

In 1879, to Sir William Thomson, LL.D., D.C.L., F.R.S., "on account of the signal services rendered to Arts, Manufactures, and Commerce by his electrical researches, especially with reference to the transmission of telegraphic messages over ocean cables."

In 1880, to James Prescott Joule, LL.D., D.C.L., "for having established, after most laborious research, the true relation between heat, electricity, and mechanical work, thus affording to the engineer a sure guide in the application of science and industrial pursuits."

The Council invite members of the Society to forward to the Secretary, on or before the 23rd of April, the names of such men of high distinction as they may think worthy of this honour.

LABEL FOR PLANTS.

The Council are prepared to award a Society's Silver Medal, together with a prize of £5, which has been placed at their disposal for the purpose by Mr. G. F. Wilson, F.R.S., for the best label for plants.

The object of the offer is to obtain a label which may be cheap and durable, and may show legibly whatever is written or printed thereon; the label must be suitable for plants in open border. These considerations will principally govern the award.

Specimen labels, bearing a number or motto, and accompanied by a sealed envelope containing the name of the sender, must be sent in to the Secretary not later than the 1st May, 1881.

The Council reserve to themselves the right of withholding the Medal and Prize offered, if, in the opinion of the judges, none of the specimens sent in are deserving.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

Friday, March 25, 1881; Andrew Cassels, Member of the Council, in the chair.

The paper read was on—

THE TENURE AND CULTIVATION OF LAND IN INDIA.

By Sir George Campbell, K.C.S.I, M.P.

My subject being "The Tenure and Cultivation of Land in India," I shall first speak of the tenure of the land. The most prominent feature throughout India is this, that everywhere the soil is held by small farmers not above the position of labourers. Speaking generally, it may be said that there are no large farmers. We found that in India under the native system the rent was in the main retained for the purposes of Government. The Government dealt with villages; those villages were little Republics—the units of the State; they managed their own affairs, distributed the revenue demand, and provided for many common expenses and common necessities by a well-arranged system of local rating. Under our system, the revenue demand has been moderated, but much variety of tenure has been introduced intermediate between the Government and the people, giving rise to very various forms of property. It seems to me that in this process we have done harm, from acting upon English ideas, in two directions. In some parts of India we have attempted to establish landlords, in the hope that they will perform the functions of English and Scotch landlords; in reality they have entirely failed to do so, and the people are under this system more rack-rented than under the native Governments. The free-trade system of free contracts between landlord and tenant has answered no better in India Ireland; in some cases great politic culties have resulted, as when throu ignorance we have imposed Bengalee a landlords over Sontals, Gardos, and oth ginal tribes, the autochthenes of the s in their view, its true owners. In other the country, an opposite course has led t class of difficulties; there, rejecting t lord system, we have made the ryots, t vators of the soil, absolute owners of the insisting upon the advantage of individ perty, we have put an end to the syste which, in a village community, the cultivators had the strength attribu bundle of sticks. This course was taken with the best intentions in t but it has turned out that in some unaccustomed form of property, give price, and without safeguards and lim people who did not understand it, has b by them as children treat a gift beyond t they have made too much use of their n credit, they have become involved wit lenders, and signed away their rights. T been sold up by the Courts under our rigid of law, and sometimes, as in the case Deccan ryots, their last state has becom than their first.

Fortunately the landlord system has been out to the fullest extent, only in Oude nine-tenths of the cultivators are mere rac tenants at will, without any rights at where great agrarian and social difficulties sulted. In the Bengal provinces, by the la permanent settlement the ryots were p and had fixity of tenure in the same wa zemindars had; and to this day the Beng sturdily maintain much of their rights; b great province of Bahar, recent inqu shown, that owing to a combination of stances, and of superiors, the Bahar ry been wholly deprived of their rights and to a very miserable position. In the Nor Provinces, the Central Provinces, and oth of India, more or less protection is give ryots. I believe that is so in Madras also hope Sir Willian Robinson will give us som mation in regard to the position of those cu in Madras, who hold under superior prop

The difficulty in regard to the ryots' p in land so imprudently dealt with, has more in the Bombay Presidency than in a part of India, and is in some degree owing to circumstances; the excessive variation in of cotton, the too sudden extension of cu under new settlements, and the sudden revenue when a revision takes place. districts of Eastern Bengal, where the t practically ryotwar, the people seem to ge well, although the titles are now very com and in the Punjaub, where individual pr combined with the village system, I hope people are really prosperous and cont spite, too, of difficulties made apparen the recent famine. I trust gentlemen w Madras and Bombay better than I do wi to tell us that, in parts of those presiden the cultivating ryots are pretty prosperou

The moral, however, of the difficulti

ave been experienced, both under the landlord stem and under the ryotwar system, seems to e to be that it was a mistake too suddenly introduce our ideas of property, and that a ited sort of property of the nature of a liberal ty of tenure is more suited, at any rate in the two or three generations, to our rule in India. regards the size of farms, we cannot expect we shall get rid of the poor and small peasant rs; nor would I, for one, at all desire to do so. s always seemed to me that, whether he work r or no, and perhaps the harder he works the r, the small peasant farmer is a more respon-pendent, managing man, than a mere labourer, better member of society, even in cases where labourer earns more money. There is no pros- of the general introduction of any system of farming; though I do not desire that, I much that in all countries variety is good, and that e, rich, and progressive farmers are very useful and as an example to others. Though I have belief in the landlord system in India, I think is very desirable, that for the purposes of large ming, some land should be available for those who desire to undertake it. In Bengal, there is immense variety of tenure and land that might, doubt, be made available for money, if it were for the immense complication of titles; in this pect simplification of titles is the great need of gal. It was the practice to give tea planters d, in fee simple, at a moderate price. and in the of land which had hitherto lain wholly waste. ave been by no means adverse to the system, ong as land-jobbing was avoided; but there at one time a great tendency to land jobbing, buse which it was very necessary to check.

may say that in India we have nowhere the e-fold function of capitalist-landholder, capi-t-farmer, and labourer, but we have in some s a three-fold set of functions, namely, the lord whose only function is to receive the rent; money-lender and banker, who supplies the to the ryot; and the ryot, who cultivates the . In some parts of the country, comparatively , the landlord combines with his own those of banker, and in this way is not gether a useless member of society, though r this system he obtains a dangerously great er over the ryots. Again, where there are no lords, the common arrangement in India is that the cultivation of the soil two parties are neces-y, the ryot who cultivates the soil, and the ey-lender who supplies him with funds, and s his banking for him. In this way there can no doubt that the village majahun is a useful, in fact a very necessary institution; very ful indeed so long as the laws are not made ly favourable to him, and so long as he is kept his place, and not encouraged to combine the tions of money-lender and land-owner. In Punjaub, under the village system, the village ahun is generally a highly-prized member of community; and among the Afghans it is not ncommon cause of strife and war among the s, that one tribe has stolen and carried off her's banker, and attempted to appropriate for their own villages. The fact is, that r our system of long settlement, by which the e risk of seasons and variation of values and oney is thrown on the ryots, it is sarcely possible that he can carry on without recourse to a banker of some kind. I have always been much in favour of the system of grain rates, valued at short intervals, by which the farmer may be relieved from much of the excessive variations to which I have alluded.

I have now come to the cultivation of the soil, which I am afraid we hardly so well understand as we do the tenure. The great question which has been raised of late years is whether the soil is becoming exhausted at the same time that the population is rapidly increasing, so that grave and dreadful evils may be feared. The population, no doubt, is increasing, but we are still without sufficient data to show the rate of increase; nor has it been made clear whether famines are really more frequent than formerly, or whether we have only had a recent unhappy cycle of famines which may have occurred in former ages, of which we have little information. My impression is, that the exhaustion of the soil is rather a thing which there is reasonable ground for apprehending, than a fact which has yet been made apparent beyond doubt as having actually occurred on a great scale. That a process has been going on, leading to much reasonable apprehension, is, I think, patent. We acquired India after terrible troubles, which had caused very much of the land to lie waste; there were many blanks; the last two or three generations have been filling up those blanks. They found much new land, which they brought into tillage; there is comparatively little left now; there is less room for grazing, less for fallows, more people to feed, and more produce exported. No doubt the soil must be exhausted in the end, if improved methods of cultivation are not introduced. Hitherto the great panacea for everything has been irrigation; but now there are very grave doubts whether increased irrigation, without increased manure, is not too much in the nature of a mere stimulant, and does not cause exhaustion, and grave evils in the end. I think there can be no doubt of this, that limited portions of the soil are very highly and skilfully cultivated by certain classes of natives in their own way. In addition to the higher classes of ordinary native produce, I might take the case of opium, which is cultivated with a care and a skill unrivalled in the world. Again, I might instance the case of potatoes, an entirely foreign vegetable, introduced by ourselves, yet the native cultivators have learnt to cultivate them very much better than we can; but then these special cultivations depend very much on the small quantity of manure which the villages produced, and they can hardly be much extended without additional manure. In truth, we must confess that we are really extremely ignorant of agriculture. Most of us who go to India know very little about agriculture of any kind; and of agriculture under the conditions of Indian soil and climate we know nothing whatever. The consequence has been, that when we have attempted to show the natives how to improve their agriculture, we have generally egregiously failed, and, to use a native expression, our faces have been blackened. In this respect I am afraid we are not improving. The old-fashioned Civil servant, if not so literary as the new class, and, perhaps, not much more agricultural, settled down more in the country, and learned more of native agricultural

habits and ways. Present administrators, I am afraid, know very little of any kind of agriculture, and it is much the same with regard to the native public servant; formerly they knew nothing of English literature, but they knew a great deal of the country; now they are very highly educated, but do not know much more of agriculture than their European superiors. I am glad to hear that a beginning has been made of sending one or two natives to the Agricultural College in Cirencester, and I hope that will be followed up. It is true that many of the free, unofficial Europeans cultivate, very successfully, tea and indigo, but they have enough to do to apply themselves to their own special articles, and have not generally given attention to the ordinary native cultivation.

My view is, that in a country where there is not sufficient wealth, capital, and education engaged in agriculture, to insure the spontaneous improvement of the country, it is the proper function of a paternal Government to do all that it is possible for a Government to do in the way of obtaining information, introducing new staples and new methods, encouraging and instructing the farmers; and when I say this, I speak not merely of an Oriental sort of paternal Government; on the contrary, I would instance the freest of free Governments, that of the United States. As regards the cultivation of the soil, the United States may be said to be a nation of small farmers, and that being so, they have found the advantage of a Government Agricultural Department; they have a most active department of that kind, not only in the various States, but also a Central Agricultural Department of the United States, from which they believe that they derive very great benefit. I, myself, believe that they do. I have seen the very active operation of the agricultural departments. It has then been a very great grief and disappointment to me, that the agricultural department designed by Lord Mayo has turned out to be altogether a sham, and no agricultural department at all. It was made to be a mere addition to the secretariat to the Government of India, dividing with another department the same work which had hitherto been done; it was overburdened with matters entirely outside the functions of an agricultural department, and practically has done next to nothing for agriculture. Our hope was that in one province of India only something practical had been done, viz., in Madras, where we heard a great deal of the successful Government farm under Mr. Robertson. I confess to having been very much disappointed when Mr. Robertson was good enough to give this Society the benefit of his experience. It seemed to me, that in his paper he told us a great deal too much about the tenure of land, and other semi-political questions, in regard to which he cannot be considered a very special authority, and a great deal too little about practical agriculture, on which we did suppose that he was an almost unique authority. I wish then to express my very great hope that her Majesty's Government will see their way to establish in India a real department of agriculture, such as exists in America. I would not be too sanguine that a revolution in agriculture would be very rapidly effected, but I feel confident that much might be done. For instance, no plant is more widely cultivated than maize. When I was in Americ
astonished to see the immense variety and
improved sorts of maize, which were exhil
different places, among which the cultivat
enormously improved, whereas in India
heard of a single soul who attempted to in
new kinds of maize. To tell the truth, I
once confess that I was some 30 years in the
service without ever knowing that there wa
than one kind of maize. To take another cas
always seemed strange that while the flax
one of the most widely spread productions
it has never been used for fibre, except,
in one small corner of the hills. An att
made to grow flax, but that attempt was
the Punjaub, the very driest part of Indi
as I know, it has never been attempted
which is the moistest part, and where,
linseed is most abundantly produced, t
supposes that flax grows best in a moi
It seems to me that an agricultural de
might very soon do much in the way of int
new varieties and new staples, and that g
some information in regard to improved m
improved manures, and machinery fitted for
cultivators might be worked out.

As to the most profitable staple, I fear that
of our old staples do not progress. The expo
sugar and silk has rather gone back; and
what I have seen of the cultivation of cott
America, and the great aptitude of the ne
there for this cultivation, I very much doubt wh
India will ever compete very successfully
America in the cotton markets of the wor
rather think that the best hope for Indian
is in the development of the home manufac
the article, by which cultivator, artisan, an
sumer will be benefited. On the other ha
well know that, on the whole, there is a co
increase of exportable produce. Wheat
likely to become a very great staple for e
and I still hope it will be so; but the diffic
which I have already alluded especially app
wheat. All the alluvial soils, which grow
well without artificial irrigation, have a
been occupied. A great extension of wheat
vation is scarcely possible without irrigation
some of the canal lands have certainly b
very much exhausted for want of manure
competition of cheap American wheat
too, much in the way. But, on the
hand, India has almost a monopoly
rice supply of the western world, and
is no limit to the demand for rice. In ri
wholly beat the Americans; Indian rice i
largely imported into America; we cannot
grow too much rice. It seems, too, th
only needs an abundant supply of water, an
it does not exhaust the soil so much as
crops. I hope that some of the rice canal
as that in Orissa, which have not hithert
very successful, may succeed in the end.
have had to struggle with very great diffi
owing to the mismanagement of the privat
panies who at first undertook them, and
demanded exorbitant rates before the
were ripe for them. There are also ver
difficulties in the distribution of water co
with the tenure of land. I hope that ther
room for a very considerable extension of t

of jute, oil-seeds, and similar great of export in Assam and some districts of Bengal, in the Central Provinces, and in er parts of India. Putting aside here all and moral questions, I think it may be a mere agricultural question, that the tivation continues to flourish, and the pium exported becomes larger year by substitute for indigo has yet been found anything else, and I believe that the may yet go on and prosper if the indigo ill only avoid the rock that threatens t is, that they cling to a feudal system g indigo by compulsion, when it would etter for all parties to give a fair price for it by free contract from free cultivators. ltivation, notwithstanding its ups and as been an immense success. I am afraid le down at present, but I do hope that lanters will not be led into unfair demands rernment for the remedy of their labour y. Unhappily, there is still a very great ty among the coolies employed in many of gardens, which imperatively requires the on of Government, in the case of coolies e not free labourers, but bound down for of years, enforced by very stringent laws. is more for freedom of contract between r and labourer than I am, but what I do o is any demand for freedom for the while there is no freedom for the One would suppose, from the things that that the Government throw all kinds les and unnecessary restrictions in the way nter, while the coolies are free to do as . The fact is just the contrary; if a gages a coolie under the ordinary civil Government in no way restricts him; but Government do say is this, that if you you have insisted, that you should have s of the most stringent character to en- l contracts of labour by criminal processes, owers put into the hands of the planters s, then the Government must exercise a pervision for the protection of the coolies, for the time, not free labourers at all, able to be sent to the most unhealthy l kept there. I have doubt, then, about the for new legislation on the subject. My r the labour difficulty, would be to give very creased facilities for the transfer of labour, ee hiring of labourers without any penal or ws at all. I should like to see as many and railways as possible, to connect the with over-abundant population with se population is scanty. In particular, very much like to see a cross railway con- e Benares and Bahar provinces through hern Bengal with Eastern Bengal and But the question of migration and emi- f the natives is a very broad and difficult hich I cannot now enter. There is still, room for a good deal of migration in ; it can only be carried out gradually and and I am myself much convinced that e people of India, and to the tropical s of her Majesty, very great advantages lt from an extensive Indian colonisa- could only make sure that Indian emi- uld be fairly treated under Colonial laws, and by Colonial admistrators, an assurance which, in my opinion, we have not yet obtained. I think emigration should be encouraged when, and only when, an Indian going to a colony is there treated in the same way as any other of her Majesty's subjects. However, I will not enter on the subject now. I am afraid I have already been too long, and I will only commend the subject of Indian land and Indian agriculture to you as being far more important to the people of India, and to all who are interested in India, than all other subjects put together. I hope that there may be fulfilled that which her Majesty's Government have put forth as their desire, namely, less of wars, and more attention to agrarian affairs.

DISCUSSION.

Sir William Robinson thought that the thanks of the meeting were due to Sir George Campbell for his suggestive paper; but he himself felt that the useful discussion of the many subjects thus discursively raised, required more preparation and opportunity for careful argument and statement of facts, than the mere listening to such a paper for the first time afforded to him. As respects the tenures of land by the ryot-proprietory of South India, he had endeavoured to explain their condition—more especially as regards the non-zemindari tracts of the country—on the occasion of discussing Mr. Robertson's paper in this room in May of last year. He had nothing to add to those observations, save that they practically apply, with few exceptions—*ex. gr.* in the Western zemindaris of North Arcot and Nellore—to the condition of landed tenures amongst ryots whose holdings are comprised within tracts of country over which a zemindari settlement still obtains. The rights and tenures of zemindari ryots are similarly, on the whole, very fairly protected against the prevalent attempts to encroach, on the part of zemindars, by the prescriptive character of the ryots' rights and titles—derived in fact from the ancient and prescriptive distribution of village land amonst the freemen of the community—by the consequences of the careful inquiry, and partial registration which preceded the introduction of the permanent settlement in most parts of the country, and by the provisions of the rent-law since enacted by the Madras Government. He would not now discuss such matters as the position of Government in relation to these tenures, "landlords," "superior proprietors," zemindari and ryotwari settlements, and the like; suffice it to say that for all practical purposes the rights and tenures of land were substantially permanent and complete throughout South India; and that this condition of the titles to land had operated so usefully that, within the last twenty-five years, the ryots had, in Madras, added at least 70 or 80 per cent. to the area of land under cultivation, and, of course, the revenue had risen—a fact which showed that the people were satisfied with their tenure, and made very good use of their land. Amongst other things, he was glad to see that Sir George did justice to the banker of India. The money-lender was spoken of as one of the great evils of India, but he thought there was no class of persons more maligned. He was, in fact, the friend of the farmer and collector of revenue alike; without this banker, cultivation could not be so actively pushed forward, or the revenue so punctually collected. It was true that the interest they demanded appeared high, but it was not higher than the accommodation was worth, nor than prevails in other poor and backward countries. In California at the present moment the small farmer did not get his money so cheap as the peasant did in India. The money-lender was a very useful member of the community, and nothing would do more harm than any legislative meddling either with his security or his position. With regard to the ex-

haustion of the soil, he thought too much was said about it; he had been a great deal through the country, and had not observed any serious deterioration, though, of course, a larger use of manure was very desirable there as elsewhere. The fact was that the extension of cultivation was bringing poorer lands under the plough. As regards rice-land, there was no doubt that irrigation brought down large quantities of silt, which was a very valuable manure. He had heard that as much as two tons of alluvial matter to the acre was brought down to Tanjore by the Cauvery, and, consequently, there was probably no exhaustion at all under this cultivation. There was probably no agricultural community in the world which was really exerting itself more heartily, and getting more out of its primitive methods of tilling the soil, than the hard-toiling Indian agriculturist. He was quite at one with Sir George as to the prospective usefulness of a real agricultural department in connection with the local Governments and Government of India, and held that widely-diffused technical instruction in the science and methods of husbandry is a primary duty. He had himself taken an active part in the movement made in this direction in South India, and looked for good, though gradual, results from all examples set to the agricultural population. Allusion had been made to the cultivation of tea and coffee, and it was a remarkable fact that directly we showed India any new product, the natives took it up at once. In the Wynaad, where we commenced the coffee cultivation about 30 years ago, the natives had followed so quickly on the steps of Europeans, that, at the present moment, the coffee land cultivated by the natives was quite equal to that cultivated by Europeans. The same with indigo; ten or fifteen years ago large houses in Madras were connected with the cultivation of this plant, but he believed the whole of this culture was now in the hands of natives. With regard to the improvement of agriculture, he did not think we should gain much by attempting to introduce English products; we should be content with endeavouring to improve the native crops suited to the country.

Mr. Charles Campbell agreed with Sir William Robinson that the majahun was a very useful member of Indian society. Few farmers in this country were their own bankers. In Scotland on market days the first thing the farmer did was to pay a visit to the bank. Now in India these money-lenders played exactly the same part as a banker. With regard to the exhaustion of the soil, he never really could see that there was any appreciable exhaustion going on, and it seemed to him that as long as there was a good rainfall, or the river overflowed in the usual manner, the crops were excellent, so far at least as Bengal proper was concerned. It depended on the season whether it should be a bumper crop or a bad crop. If it were a bad season, everybody was inclined to cry out about the exhaustion of the soil, but with a good rainfall one heard nothing about it. Cultivation had been going on in India for thousands of years, and if there had been exhaustion going on, he thought we must have heard of it hundreds of years ago, and there would be no production at all now, because the use of manure was very limited. He was rather doubtful about the utility of the agricultural department till we had ourselves scientifically studied the subject. In truth, we knew very little of Indian agriculture; and he did not think it could be much improved until we knew more about it. We certainly had not improved Indian art, we had improved their manufactures off the face of the earth, and if we attempted to meddle too much with agriculture, though of course immense improvement was possible, we might do the same thing. There were some things which were urgently required. For instance, the introduction of some green fodder was much wanted. Passing through Egypt, one was much struck by seeing the long lines of camels bringing in clover or vetches, or green fodder; and something of that kind was greatly wanted in Bengal. The cattle there were mis
because they had no decent grass to
could hardly call them bullocks at a
many districts of Bengal, simply sk
commons which were formerly reser
holders and village communities for
cultivated, and really there was no
seasons but dirty indifferent rice
miserable cattle to eat. Sir George
about the ryots of Lower Bengal n
rights, whilst those of Behar seemed
the wall; and it did seem that in
much worse off. The ryots in certain
in Eastern Bengal, were much better
places; but in Birbhoom and Kish
districts near Calcutta, nothing coul
than the state of the ryots; they w
helpless creatures as you could conce
done for them, the landlords who re
living in Calcutta and squandering the
of luxury. He recollected, about ten
of these people were dying, simply f
and they lost hundreds of cattle fro
He was rather in favour of the perm
His brother (Sir George Campbell) all
lords of Bengal not carrying out a land
he did not suppose there was any inh
the landlords, whether black or white;
same in reality, and if they were mad
duties they did so, but not otherwise.
never made the least attempt to n
do his duty to the ryot; it had m
settlement, and left landlords and the t
out amongst themselves. There was
the rights of any class of ryots. I
so far as they had managed to mai
it had been in spite of the Govern
of the landlords. He had lately be
and he must say that every featu
was there exactly reproduced, and
same remedy which had been applied
have the same effect in Ireland. T
on the face of the earth more practic
ryot. They all knew what jute wa
every article almost of clothing, ca
few years ago only half a millio
England. The moment you show
would pay him, he entered into it wit
an European. It was the same wi
places it was replacing the cultivation
had been mentioned, and they were
trict round Calcutta in large quanti
the European troops. The soil was f
ryot never attempted to sow them
would grow successfully.

Mr. Pfoundes said that allusion was
to the United States Agricultural Bur
to have some information about tha
knew the opinion of intelligent Ame
tion, as well as having had, se
experience of one of the offshoots of
bureau. At a heavy expense, and w
of trumpets, this bureau was plante
was sorry to say that the resu
in proportion to the expense, and
to see anything of the kind trans
He had some knowledge of the C
to 1863, and he thought that In
or any other Asiatic who went the
treated, if they were only law-abi
self-interest of the colonists would
them well, and besides we had Engli
there almost to perfection. Instead
bureau, which might succeed fairly
under certain conditions, but which,
most likely possess all the faults of
ism and English red-tapeism bro

...ught it would be wiser to subsidise an Aclimatisation ...ciety, with branches in the various provinces, and by ...ir means a great deal might be done. When a ...ng man, he saw something of the Climatisation ...ety in Melbourne and Victoria, which did great ... during the first five or six years of its existence. ... necessary to be very careful in transplanting ...ean, American, or alien ideas of any kind to Eas... ...ntries. He spoke not so much of India as of the ...es further east; but Sir Edmund Hornby, who ...reat authority on matters connected with the ... one occasion told some official Japanese gentle... ...strongly advised them in the revolution they ...e entering upon, not in any way to touch the ...andlords, or native agriculture—above all ...o be most careful not to interfere with the ...ler of the soil.

...obert Cust, having expressed his disappoint... ...that Sir George Campbell was not able to be ...t, and his high appreciation of the practical ...ggestive character of the paper, said there ... four distinct tenures of land in India, that of ... southern part of India, which Sir William Robin... ... had alluded to, the Bombay Presidency, the ...al Presidency, the North-West Provinces, and ...e Punjaub, in which Sir George Campbell and him... ... had spent so many years. There was essentially ... same system of tenure there, and the officers of ... State took to themselves the credit that their ... was not a new creation of the English, but a ...ration of the old institutions of the people. ...y did not create great landlords and nobles, as ... done in Bengal; or break them up into miser... ... ryots, as in Bombay. They accepted the ...ge system, and the village proprietors as the unit. ...y found the head men of the village representing ... proprietory, and below them, cultivating tenants of ... classes, those with rights of occupancy, and tenants ...ill. When they moved in and took the Punjaub, ... came then to a virgin soil and a kindred people, ... they then found the value of their system entirely ...rmed. They went from village to village, and in a ... short time the settlement was concluded under the ... village system which had outlasted dynasties. Many ... village communities had lasted down from the ... immigration. He did not say that they had existed ...thern India; perhaps they did not, but they had, ...ly, been caught alive in North India, and the ... had been to perpetuate them, not to destroy ... The great secret of governing oriental countries ... let the people alone. Lord Lawrence's maxim ... easy settlement and a rapid collection, with no ... In this way, they never had any trouble, ... people knew there was so much to pay for each ..., the accountant made up the accounts, and the ... man paid the bill. If they attempted to interfere ... much with the people, as, he was afraid, had been ... in Bombay, dealing with each individual, and ...ing the rent-roll of some thousands of individuals, ... much room for oppression on the part of native ... In the North-West Provinces they dealt with ... villages by their head men, and that was the secret ... their prosperity. Everybody who had studied the ...re of India must think of Ireland, for the cir... ...stances were, in many respects, the same, and the ... remedy should be applied to both. In India they ...gnised that there were in the land two distinct rights ... rights of the proprietor and the rights of the ...nt. Both were able to co-exist. They recognised ... the landlord had a limited right in his estate, and ... the tenant had his right to the produce on his pay... ... the rent; the landlord paid the revenue to the State; ...w the rights of the tenants were guaranteed, and ...thing of the same kind would have to be done in ...nd. He agreed with what had been said about the ...y-lenders or bankers; the business of the country ... not be carried on without them. He doubted whether it was the business of the Government to meddle with agriculture; we had enough to do to collect the revenue and keep the place; the great thing was to let the people alone, though you might have a model farm if you liked as an example. The people knew their own business best; they had been going on in this way for 2,000 years; the land never got a fallow, but it produced magnificent crops, sometimes two in one year. He believed the people were quite sharp enough to guide themselves, and he doubted whether an agricultural department would be of any use. The great enemy of India was Manchester; and if India were governed by an independent Legislature, such as the Colonies and the American States had, they would never allow their rights to be trodden down for the benefit of a great manufacturing town in England. He was convinced that India suffered from the influence of deputations coming from Manchester to the Secretary of State, and pretending that it was to the interest of India to do so and so, when it was really their own pockets they were thinking of. Indian officials, whatever their faults might be, stood up for the people of India, and he hoped that the feeling would grow, that India ought to be considered as a great empire of itself, and not merely as a province of England.

Mr. Pal Chowdhuri said as he came from Bengal, he would state what the land system of that district was. By the permanent settlement, the zemindaris held large tracts of land, the rent of which was fixed, and they let it to the actual cultivators. These cultivators held the land under two different systems, one what was called the lease system, where the land was leased out permanently, or for a certain length of time, and another system under which the tenant only occupied for one year, and when the crop was over, he might, if he liked, leave that piece of land and go to another. There were a good many villages where there was no fallow land at all, and there the ryot would be obliged to cultivate the same piece of land again. There in such places the lease system was more prevalent, but leases again might be permanent or temporary. Where it was permanent, the rent could not be enhanced by the zemindaris, but by the temporary lease at the termination of the lease the rent might be raised or not, according to the condition of the village and the land. He agreed with Sir William Robinson that the money-lenders were most useful members of society, especially in Bengal, where the rent was payable at a certain fixed date, and if the owner did not pay, his property must be sold, so he was obliged to collect the rent from the ryots. If there were no such class as these money-lenders, property would be continually passing from hand to hand by forced sale. He agreed that there were some who did not treat their customers very well, but on the other hand some were very lenient, and went on lending to persons who could not pay their debts even for years. If there were a few persons in a village who could not pay their debts, the money-lender could not stop lending to them again, or the whole village would come to him and insist on his helping those poor persons. With regard to high cultivation, he did not know whether the time was come when it could be introduced into India profitably. Of course manuring and high farming increased the produce, but if a farmer could cultivate a piece of land for ten rupees which yielded him fifteen, he then got five as his nett profit. If he cultivated it highly, it would cost him twenty rupees, and instead of fifteen he would get twenty-seven, which would give him a nett profit of seven rupees from the same piece of land instead of five; although his profit was increased by two rupees, he had spent twenty instead ten, so that the per-centage of profit was decreased from fifty per cent. to thirty-five per cent.; and as there were plenty of fallow lands not yet cultivated, it would pay him better to take another piece equal to the former, and expend the extra ten rupees upon that, in which case he would still get his fifty

per cent. profit. So long as labour was cheap and land abundant, he did not think high cultivation would be profitable, though no doubt the time would come when the European system would be necessary.

Mr. A. Rogers (late member of the Bombay Council) said the presidency of Bombay had been much looked down upon by some speakers, and described almost as a sink of iniquity, in which the rights of everybody had been ignored, but he could assure them that that was by no means the case. Where they had found proprietory rights existing these had been preserved, and it was by no means the case that a simple ryotwari tenure existed throughout the whole Bombay presidency. When the country was first taken over, it was not found that there were hereditary farmers to any great extent, but those who paid the revenue of the villages were persons to whom the right of levying the rent had been let out by the Government of the day; but where they were hereditary their rights had been preserved. The system amongst the Mahrattas was that of farming out the revenues to the highest bidders, who were often court parasites. When the new system was introduced, they endeavoured to protect the ryots against the exactions of those who were merely farmers of the revenue, and that was how it came to pass that the village system broke up in some parts of Bombay. This was specially the case in the Deccan, and in a portion of Guzerat. Having had a great deal to do with the land settlement, he could say that a system was introduced which enabled each man to stand on his own feet, and work for himself, which had been of the greatest importance to the people. In many cases they had rescued the agriculturists from virtual slavery. There were certain classes who were called Nirwadars, in Ahmedabad, Bhagdhars, in Broach, and Talukdhars, who had certain proprietory rights, which had been preserved; but under these heads of villages there were other tenants, who had rights adverse to them — tenants who had customary rights, just as there were in other parts of India, and those had been most strictly preserved. With regard to the introduction of the agricultural department, he thought they should be very careful how they attempted to interfere with the systems of native agriculture. The natives knew very well how to take care of themselves. Much had been said about introducing the system of deep ploughing, but he thought it should not be attempted except with very great caution. Such a system had never existed in India, but if it had been the right system, he thought the natives would have found it out before now. There were, doubtless, fertilising principles lying deep in the soil which, if they were turned up to the surface, and exposed to the sun for seven out of the twelve months, would disappear; whereas, now nature provided that they should remain deep in the soil, and provided the plants with sufficiently long tap roots to reach them. He also agreed with the usefulness of the majahun.

Mr. Shore desired to say a word or two on the land system of Orissa, a province very interesting in many respects, both from its natural features, and the state of things existing when the English conquered the country. It offered a contrast to the rest of Bengal, in this respect, that it had not been subjected to the permanent settlement. They had certainly committed the same error—if it was an error—to some extent which Lord Cornwallis, or the previous Governor of Bengal, committed, in recognising at once the classes which were employed in collecting the revenue as the proprietors of the land. It was quite true that in the permanent settlement it was stated that the rights of the ryots were to be ascertained and recorded; but that was not done. In Orissa there were more hereditary rights on the part of the zemindars than in Bengal, because the country had never been so thoroughly conquered by outsiders. At first they made a great bungle of it; and partly in consequence of the oppressive demands made on the land, there was a which opened their eyes t serving the rights of the pe detailed and minute settl principle of which was exac have been recognised in the not in practice, and had be They recognised the rights o hereditary and indefeasible revenue to the Government insure the rights of those w There were two description and hereditary resident ryot their property absolutely s as they paid their rent, whi by the zemindars by one f to the land for which th allowed to have a consider rent. These people had well of the demands upon ryots had not these advanta rents raised upon them, not o by the middle men, of whom some of whom had a per-ce of the produce of the rent quantity. This system, on test of experience extremely to the country, there was a g at that time, instead of their land, the great proprietors for ryots, and, in some cases ryots, and gave them hom majority of cases, it was t they desired to have on the known cases of affrays bet for the possession of these however, of the increase in p position of things was now tion was now more for land was another peculiar tenu Orissa, in the sacred dist Juggernaut. There were mins, who held the whole ject to a very small quit nothing at all. These me maintenance of their rig years ago stated that they stubborn set he had ever they were an independent revenue settlement was r cultural system of India. land had gone out of c been oppressed and m non-existent, the peop extravagant; but wher tributed and tolerably had been better than w The admirable results Orissa were very muc ing and preserving t much felt that somet Bengal, by Aitkin, innumerable law suit down. The two gre distinctly, both the occupancy. The re held for a certain n they could never h of occupancy wer twelve years in the rent could not be country, which he rent system of Be cisely the same w

Mr. Long said was now twenty the interior of F

Emperor employed to carry out the serf eman- , and the system which had prevailed in India me immemorial had prevailed in Russia for es, and had worked wonders. Had that system eloped further, we should not have had the hich occurred lately, but, unfortunately, it and a reactionary system took place. Each d a representative, and these representatives rt of county assembly, and that led up to a ssembly. It should have been carried further l assembly, but that was not attempted; still od had been done in Russia by the system. rd to the Bengal ryots, they owed an bt of gratitude to Sir George Campbell, who, ed much opposition by the educated classes, was the friend of the ryot, carried out reforms uld carry his name, with that of Sir J. P. wn to posterity as the benefactors of Bengal.

l Maclagan, R.E., with reference to the which had been made regarding exhaustion of n India, did not think they had yet sufficient le data to form any conclusion on this subject. was one matter which greatly affected the of the land in certain parts of the North-West and the Punjaub, which had not been alluded hat was, that a certain injurious salt, called its appearance on the surface of the ground, r large areas out of cultivation. It has xtensively on lands irrigated by canals, and y where the irrigation channel was a little evel of the country. The water sank into and percolating there arose to the surface ith it this injurious salt. The *reh* is chiefly soda. It has sometimes been supposed to canal water, but the same water irrigates without producting *reh*. It appears to be and to be brought to the surface by the en near the surface, it comes out after rain, n ravines in the neighbourhood of Lahore. r W. Sleeman, in his "Tour in Oudh," he occurrence of *reh* in that province on lands, and describes the remedy there hich was to divide the field into very small th little raised banks between; these were n water, which gradually sank into the soil, e salt with it, sufficiently to allow at least be raised, and, when necessary, the process d. Of the lands which have been watered stern Jumna Canal, there are many square ich, from this cause, no crops can be grown, hich the *reh* is so copious as to have the of snow. On *reh* land it has been found n kinds of vegetables can be grown, but, enerally, the land so afflicted is thrown out on. The matter has attracted much notice, leterioration of lands from *reh*" has been the much correspondence. It continues to ntion as a matter of some scientific interest, ractical importance.

irman said he thought it was impossible for o had not had to deal with the land revenue give any opinion on the subject of land th listening to, and not having had that he would not touch on that point; but with the remarks made on the subject of agri- was strongly of opinion that the natives had al to learn, and he concurred in the r George Campbell. Most of the gentlemen d a different opinion, and seemed to think the very little to learn; but still, from their own thought their conclusions might be disputed. he natives were very quick to learn, and when introduced a new process, they immediately p, which evidently showed that they could and were being taught. He was much years ago by a dispatch written by the late Lord Mayo on the 6th of April, 1870, from which he would read a few sentences. Lord Mayo said that, "of all branches of Indian industry, agriculture, which constituted the occupation of the great mass of the people, was by far the most important, and he believed it to be susceptible of almost indefinite improvement." Again he said, "for many generations to come, the progress of India in wealth and civilisation must be directly dependent on her progress in agriculture;" and again, "it was hardly too much to say that a scientific knowledge of agriculture in India had not at present any existence." Those were very strong words; and many old Indians with whom he was acquainted said they were incorrect; but, on the other hand, many others who were well versed in agricultural matters, considered them perfectly true. He did think there was much to be done in the way of improving agriculture in India.

Mr. Long said he was for several years a member of the Council of Agriculture; and they found the natives were very careful in learning, but they did not understand principles.

The Chairman said some gentlemen had spoken as if there were an idea of compulsion in this matter; but nothing of the kind was ever dreamt of. All they wished to do was to show what could be done, and leave the natives to follow what appeared to be for their good. A relative of his own, when home some years ago, went through a regular course of agriculture at Cirencester, and he heard he had recently been giving lectures on agriculture in Katimour, and hoped good would result from them. He must take exception to the remarks of Mr. Cust, who had attacked his old friends in Manchester. What harm had they done? The only harm they could have done was in depriving India of a portion of revenue from import duties; but surely if Manchester had given India goods 5 per cent. cheaper than before, it was a very good thing for the consumer. Again, if Manchester sent large quantities of cotton goods there, she imported large quantities of cotton in return, and had greatly increased the demand for its cultivation in India. Speaking from some personal knowledge, he could state that no part of the kingdom had been more earnest in pressing on the Indian Government the necessity of constructing works of irrigation, railways, and every improvement of that description, than Manchester. The men of Manchester were no more selfish than other people, and he could only say that if India had men as energetic, as enterprising, and as industrious as they were, she would do exceedingly well. In conclusion, he proposed a vote of thanks to Sir George Campbell for his interesting paper.

The motion was carried unanimously, and the proceedings terminated.

SEVENTEENTH ORDINARY MEETING.

Wednesday, March 30th, 1881; C. W. Siemens, LL.D., F.R.S., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Culley, William Richard, 15, Maryon-road, Charlton, S.E.
Dale, George Williams Melville, Ellerslie, Nether-street, North Finchley, N.
Davis, Moses, 27, Wellclose-square, E.
Knight, William Duncan, Avening-house, Greenhill, Hampstead, N.W.
Mackie, John, 2, Victoria-villas, Queen's-road, Reading.
Pope, Joseph John, M.R.C.S., 4, South-crescent, Bedford-square, W.C.
Rowan, Arthur Hill, 6, Westminster-chambers, S.W.
Thornhill, W. George, 36, Eastbourne-terrace, W.

The following candidates were balloted for, and duly elected members of the Society:—

Adlam, James, 28, Aldebert-ter., Clapham-road, S.W.
Beaumont, Colonel F., R.E., 3, Victoria-street, Westminster.
Browne, Harold C. Gore, M.A., 6, New-square, Lincoln's-inn, W.C.
D'Avigdor, E. Henry, B.A., Derwentwater-house, Acton, W., and 15, Great George-street, S.W.
Donaldson, J. Hunter, 176, Oxford-street, W.
Greenhough, David William, 9, Mincing-lane, E.C.
Henry, Ebenezer Walker, 27, Belsize-crescent, Hampstead, N.W.
Maberly, Capt. Thomas Astley, 25, Parliament-street, S.W.
Mansfield, George, 104, New Bond-street, W.
Potts, Benjamin L. F., A.M.I.C.E., 174, Camberwell-grove, S.E.
Price, John Edward, F.S.A., 60, Albion-road, Stoke Newington, N.
Welsh, Thomas Debell, 79, Arthur-road, Brixton, S.W.

The paper read was—

RECENT ADVANCES IN ELECTRIC LIGHTING.

By W. H. Preece.

I am here this evening to describe to you the recent advances that have been made in electric lighting. My position reminds me of a story that is told of Queen Elizabeth, who, on approaching a certain town, was not received on arrival with the usual ringing of bells. On demanding the cause, the chief municipal dignitary informed her Majesty that there were 39 reasons why the bells did not ring, the first of which alone satisfied her Majesty, viz., "there were no bells." So I can almost say "there are no recent advances in electric lighting to chronicle." The advances that have been made have not been so much in electric lighting itself as in the popular favour with which it is regarded. The public is becoming more accustomed to its use, and therefore acquiring more confidence in this mode of producing light.

Electricity and gas are playing a see-saw game. As the electric light goes up, the gas goes down. It reminds one very much of those old Dutch weather houses that used to be common many years ago, but have recently disappeared. When the weather was fine, out came the old woman; when the weather was damp, out came the old man. Electricity made a great splutter in Paris; down went the gas shares. Mr. Sugg and his inventions brought the gas shares up again. An alarming message is received from New York; down goes the gas again. The friends of gas have scarcely had time to recover themselves when the City of London, with great wisdom and foresight, votes a very large sum of money to be expended in carrying out a gigantic electric lighting experiment, and this has brought the old man out once more.

The result of trials during the last year or two have been to give experience in the vagaries and capriciousness of this light. Its defects have become better known. We have been taken out of the experimental, and have been brought within reach of the practical stage. Now details are being elaborated, mechanical appliances supplied, and much useful knowledge is being acquired by those who have had the enterprise and the farsightedness to launch their money in new venture.

The progress of electric lighting can be lo at from three points of view—scientific, mercial, and practical.

My task has been rendered very light, b admirable series of Cantor lectures that recently been delivered in this room by Pr Adams. He has thus enabled me to shake away from scientific detail, and to deal more commercial and practical generalities. I therefore, glance rapidly at the commercial practical developments of the principal portio the system which together make up electric ligh Let us first take the motor, the power by w scientific skill has enabled us to convert a so energy into another form. The problem we to solve is how to extract the greatest amou light out of a lump of coal. Of our agents us, the poor old engine is much neglected. I think of the work done by that willing engine, I am reminded of the story of the and the organ-blower. The blower said to the organist, "How magni played Handel's . . . . . to-day!" played,'" replied the organist, "You tinent fellow, what do you mean played?'" The blower said not a word, the next occasion when the organist play, the blower declined to exert himsel on being remonstrated with, he said, " play, or do we not play?" The organis "Yes, we do play," and instantly the orga forth. So with the engine, where should without the engine? The reason why the light has, within the last few years, come to the front, is because electricity has be duced by the direct conversion of me energy into electricity, instead of by batteries, which were the only sources know ago. Now, thanks to the steam-engine, able to fulfil all those requirements that to produce cheap electricity. Those requir are high velocity, great steadiness, and pressure; and those are the points whi gradually being acquired in the steam-engi duced from our workshops. The veloci 800 revolutions per minute, sometimes double that rate, is an enormous velo maintain, but it is essential for cheap ele Eight hundred revolutions a minute frighten us, for we care not what the rotation is, in the wheels of our trains. No one troubles his head much ab tremendous velocity acquired by a carria runs continuously for 24 hours or mor therefore, we need not be alarmed at the acquired by our stationary engines electro-dynamo machines. It is not too say that what little success belongs to the light on the Thames Embankment, is du engine planted beneath Charing-cross br Messrs. Ransome, Sims, and Head. Nor say that the success of the electric light in th Museum is due any the less to the Wallis and engine than to the magnificent apparatus by Siemens Brohers. It would be invi name the different engineers who have brou special engines for this purpose, for their legion. Marshalls, Brotherhoods, Rob

have worked hard in this field, and have led in producing engines which, by auto-governors and by other means, provide all equirements that the electric light demands. uld be difficult to over-estimate the good has been done in this direction by the com-ive trials instituted by the Royal Agricultural ty. The small engines that distinguish [illegible] engineers, are almost entirely due to the [illegible] excited by these annual trials. Instead of [illegible] power requiring 7 lbs. and 8 lbs. of [illegible] produce it, it is common now to find [illegible] producing one-horse power by even 3 lbs. [illegible] in some engines 2 lbs. per horse-power [illegible] been attained. It is strange that nothing [illegible] done to supersede steam as a generator of [illegible] It is well-known that the specific heat of [illegible] higher than that of every known substance, [illegible] is not beyond the reach of theory to assert there are other liquids whose evaporation produce the same power with a very much penditure of fuel. There is a vast field for [illegible] in this direction. The gas-engine is a economical source of energy, and has been ccessfully applied to electric lighting in laces. At the Docks in Newport, South [illegible] gas-engine has been in use for nearly two th great success; and it is worthy of note 00 cubic feet of gas per hour gives a candle [illegible] 300, that same gas applied to an engine ive, in electricity, a candle power more imes greater, namely, 3,750 candles. Here re to maintain gas dividends.

[illegible] is another convenient source of energy, [illegible]u can find it available. Sir William [illegible]ng, at Craigside, near Newcastle, has a brook for this purpose, and, by the aid [illegible]rbine, produces a force giving six-horse [illegible] in fact, he says "the brook lights his

[illegible]not aware yet of air having been utilised purpose, except when heated in the caloric in use at the Lizard Lighthouse, which is [illegible] be economical, useful, and very suitable [illegible] isolated places where it is difficult to pro-[illegible]ter. It is, therefore, clear that some [illegible] have been made in the economy and [illegible]ptability of motors for electro-dynamo [illegible] to produce the electric light.

[illegible] regard to the generator of electricity, the [illegible]ent by which the energy of steam or water [illegible]rted into electricity, after Professor Adams, [illegible]h remains for me to say. There are several [illegible]t machines. The difference between each much the difference between tweedledum [illegible]edledee. Each is specially adapted for its [illegible]rticular work, either by a variation in [illegible], or by a variation in the way in the wire is wound, so as to produce [illegible]tion in the current produced to suit [illegible]ticular light required. The efficiency of [illegible]chine is the amount of energy which is [illegible]d into current, and it has been shown that the Siemens and the Gramme machines [illegible]0 per cent. of the power is converted into current. It is easily demonstrable that economy in the use of small machines, and [illegible]fficult to understand the reasons that [illegible]ome people to speak of the value of the [illegible] machines that have been constructed in America. In fact, in this department, a great deal of time and energy is being wasted in trying to gild refined gold. Changes are being introduced for the mere sake of change. The improvements that have been made have been improvements in detail only. Broadly speaking, there are two classes of machines, those which produce continuous currents, and those which produce alternate currents. Very little advance has been made in the efficiency of the earliest forms in every case; and I learn from Mr. Douglass, of the Trinity-house, that the original Holmes magneto-electric is still in use, and doing good work, at the Souter Point and South Foreland lighhouses, and that a De Meritens magneto-electric alternating current machine, of similar type, has been under trial at the Lizard for the last four months, and that he is greatly pleased with its efficiency and reliability. The De Meritens machine is an excellent one, and one of which we shall hear more. The trials made for the Trinity-house showed that more efficiency was obtained by joining up small machines in multiple arc, than either by the use of a larger machine, or by the same machines joined up in series. This is a point that has escaped the notice of recent experimenters in this direction, and it is well worth their serious consideration.

The battery has been discarded as a generator of electricity from its want of economy, but there are hopes that secondary batteries will be introduced for the purpose of storing-up this force. No advance has yet been made, however, towards the practical attainment of this desire. Many attempts have also been made to utilise the thermopile, but in all cases it has been shown that the electromotive force produced is too low. The thermopile has this advantage, that it is wonderfully durable. I saw, last week, one which has been in use for four years uninterruptedly, night and day, without intermission, and it still gives out electricity with all its pristine vigour.

The conductor is the broad road along which electricity flows to produce light at a given point. In all cases, from its superior conductivity, copper has been selected. Sometimes this copper wire has been carried overhead and sometimes underground. Where it can be carried overhead, it has the advantage over underground that, as the heat radiates into the open air, the wire itself becomes cooler and conveys more electricity. In practice, the purest copper is used, and wire of the largest dimensions consonant with economy, for the resistance or obstruction to the flow of electricity must be maintained as low as possible, to prevent waste of energy. In the different experiments which have been carried out in London, one feature noticeable to me has been in some cases the utter ignoring of the experience gained in telegraphy. The way in which wires are suspended, and hung, and moved about, is to the mind of the telegraphist simply disheartening and appalling. On the Metropolitan Railway the wires were so decayed, and rotten, and ill-used, that they had to be removed, and the lighting of the Victoria Station of the Underground Railway was abandoned. The currents used for electric lighting are more than 3,000 times greater than those used for telegraphs. We have great difficulty in maintaining the small currents used in telegraphy along their proper course, and the

small defects that have, in thirty years' experience, made themselves evident to us, are simply magnified in their hurtful effects 3,000 times when applied to electric lighting currents.

Electric currents have also a peculiar and serious influence on wires passing in their neighbourhood. It is an influence called induction, and one that produces serious disturbing effects. In fact, so powerful are these disturbing effects, that very great fears are entertained that it will be impossible to maintain electric light and telegraph circuits close together. Recently at Holyhead telegraph communication was completely broken down along a wire that ran side by side with the wires conveying an electric light, during the time the current flowed to produce the light. We of the Post-office are watching carefully for any interference by electric light currents in this respect.

Why do electric currents produce light? Light and heat are mere terms given to what are really similar operations. Certain undulations impinge on the retina of the eye, and give that sensation which we call light. They fall on our skin, and produce the sensation of warmth. They are incident on certain salts of silver, and produce photographic pictures. The flow of electricity means the generation of heat. The production of light is the accompaniment of intense heat. In fact, the brighter the light, the intenser the heat. The art of producing brilliant light is the art of producing high temperature. There is no greater illusion extant than that the electric light is a cold light. The electric arc is the greatest source of heat known. Our worthy Chairman has shown us how it can reduce to liquid the most refractory metals; and at his country house, near Tunbridge Wells, he has kept a stove-house at 70° by its aid. Professor Dewar measured the heat radiated by the light he used, and found it sufficient to produce three-horse power per minute; hence electric currents produce light because they produce intense heat.

Now, this heat can be produced either by causing the electricity to fly across an air space, in which case we have light by the arc, or by causing it to flow through a small wire, or a carbon filament, which offers obstruction to the flow, and produces light by incandescence.

We have burning to-night several specimens of each kind. The forms of arc lamps are very numerous. In every case carbon rods are opposed to each other, and they are disintegrated and consumed in the fierce blast to which they are subjected. The lower pole—the negative—acquires a temperature of 3,150° C., it is broken up and fired with a fierce bombardment of white hot molecules across the air against the upper pole—the positive —which is beaten up by incessant impacts into a higher temperature of 3,900° C., the arc itself being 4,800° C. On account of the irregularity in the character, and, therefore, the consumption of carbon, and the variation in the strength of the current, various ingenious appliances have been adopted to obtain steadiness and uniformity in action. Mechanism, clockwork, electromagnetism, gravity, and all kinds of contrivances have been called in; in fact, of arc lamps, their name is legion.

A remarkable attempt was made by Jablochkoff to dispense with mechanism altogether in his candle but though many thousands of them are in use, it is doubtful whether the candle system will be permanent, for it is expensive and wa[illegible] ful. M. Jamin has recently taken a step in adv[illegible] in this line, and the trial of his lamp is be[illegible] eagerly watched.

We have not yet obtained perfection in the [illegible] lamp. We want brilliance, combined with ab[illegible] steadiness, and the durability of a winter's [illegible] Great steps have, however, been made in simp[illegible] tion of parts and smoothness of action; [illegible] lack silence and steadiness.

Many of the defects of the arc light are [illegible] pensated for in that of incandescence. H[illegible] have something that is beautifully soft, ab[illegible] noiseless, perfectly steady, a light that bri[illegible] up Nature in all her true colours and [illegible] shall not readily forget a dinner party gi[illegible] Mr. Spottiswoode, the President of the [illegible] Society, a short time ago, when his roo[illegible] illuminated by Mr. Swan's lamps. It w[illegible] only fascinating, but fairylike and lovely. [illegible] felt in a dream. We have had a samp[illegible] here, and the beauty of the light grows [illegible] The incandescent light is, however, at pre[illegible] expensive luxury. It requires a consi[illegible] penditure of power. For instance, Sir W. [illegible] strong finds that six-horse power supplies 3[illegible] giving altogether 925 candles. Six-horse p[illegible] arc lights would give over six thousand c[illegible] However, we must not grumble. Rapid pro[illegible] is being made in this field. Maxim, Edison, [illegible] in America; Swan, Lane-Fox, and othe[illegible] England, are working hard, while Gordon [illegible] Joel are working in an intermediate field, wh[illegible] prospect appears of a happy compromise [illegible] affected between the arc and incandescence. [illegible] have, to-night, an illustration of the burni[illegible] the Joel lamp—a modification of that intro[illegible] by Mr. Werdermann.

A good many wild statements are made [illegible] the light-giving power of these different l[illegible] A standard sperm candle may be a very goo[illegible] to measure gas by, but it is a very poor st[illegible] for the electric light. Of course the advo[illegible] the electric light over-estimate their ca[illegible] would not be human nature if they did no[illegible] their divergences are wonderful. Thus, the G[illegible] committee makes one horse-power produ[illegible] candles; the Trinity House, 1,254; a Pari[illegible] mission, 2,500; a certain Anglo-American [illegible] Company, an unknown quantity!

We have two natural standards to refer to, [illegible] light and moonlight. We have various p[illegible] forces to appeal to for measurement, photo[illegible] records, the production of heat, the estim[illegible] shadows, &c., but the standard of the [illegible] remains an *ignis fatuus*. To estimate the v[illegible] a light, you must not look at it; you must [illegible] your back to it; you must try and read small [illegible] by it, and then you will find what a god[illegible] would be to find some means by which we [illegible] estimate the illumination of a square foot [illegible] square yard. We want not only a new sta[illegible] of light, but we want a new system of photom[illegible] Efforts have been made to estimate the int[illegible] of the light radiated by the size of the craters [illegible] on the carbon rods; but this mode of measur[illegible] is empirical and illusory, for it varies wi[illegible] character of the carbons and the currents us[illegible]

A word about that "philosopher's stone," [illegible] *elixir vitæ*, the subdivision of the electric [illegible]

sit mean? It means that certain gentle-
e, from one central spot, to distribute
y, as they do gas and water, throughout
es, so as to furnish great cities with cheap,
d abundant light. "'Tis a consummation
to be wished." Now I am one of those
not believe in the word "impossible,"
y, that with our present knowledge, this
is insoluble. There are those who don't
at who think I am an obstructive lunatic.
at are the facts? Numbers, thoughts,
an be manipulated anyhow—hence Whig
y, High Church and Low Church,
omne, but facts are inexorable. Sir
Armstrong, can only keep 37 lights going;
could only show 12 lights; Professor
uld only produce from the most powerful
machine, by calculation, 140 lamps.
the subdivision? The advocates of sub-
ssume an inexhaustible source of elec-
Their opponents reply that there is but a
ted source of energy in every dynamo-
Subdivision means loss of power, waste
and useless expenditure. We are not
illiam Armstrongs, who can say of
"I can afford to waste that which
othing." One ardent disciple of sub-
ys, "There is practically no loss in
e electric light produced by this means
escence)." Now, is the production
dles when you ought to have 6,000
the production of 3,600 candles on the
bankment, where you ought to have
oss? Our dynamo-machines have their
o power on earth, either of subdivision
ltiplication, can make the machine
an a given amount of work. It may
ourse of time, and, probably, very soon
owerful machines and lamps of lower
may enable us to light up a greater
one circuit, but this is not subdivision,
lication. I anticipate more advantages
ansmission of power, and I look forward
when I shall have in my own house a
simple dynamo-machine, working my
, and no one else's. I have not the
mbition to be dependent on electric
nerated miles away, and liable to all the
ns to which I, as a telegraph engineer,
ong and painful experience.

ring got our light, the next question is,
we utilise it? This question, as far
illumination is concerned, is about to
or us in a very interesting way by the
rities. We have, first, the centralised
Dr. Siemens, where one machine works
ful light, raised like a small moon upon
a high mast; and we have, secondly,
ited system of the Brush Company, who
existing street lamp-posts, one machine
any lights. I have no doubt myself,
wn observations, that for symmetrical
rge areas, such as docks, parades,
., the former is the best; but for long
streets and thoroughfares, the latter
superior.

e arguments apply for internal illumi-
othing can be more perfect than the
system at the British Museum, while
ated system would alone meet the case of such a place as the Waterloo Railway Station. For the former we want height and space; for the latter, length and lowness. In fact, the longer and lower the place to be illuminated, the less is the intensity of the light required; and when we come to long rooms and passages, we possess all we require in the small incandescent lamps. It is not difficult to show that such conditions may arise, even in external illumination, that a few small lamps, well distributed, will illuminate better than one or two powerful ones.

An eventful feature in practical lighting is the proper scattering or diffusion of light, by shades, screens, and reflecting surfaces. There is an archway at Waterloo Station that is wonderfully lighted, owing to the white glazed tiles on its sides, forming such admirably reflecting surfaces. We want to emulate the diffusion of daylight. It is marvellous how whitewashed surfaces do this. Well selected globes act as though they were self-luminous—they scatter light and prevent shadows.

The reason why daylight is so diffused, and the light searches out the inmost corner of our cupboards and our drawers, is simply that practically the whole sky becomes the source of illumination, light radiating from each point. One interesting question that will be solved by the great experiment commencing to-morrow in the City, will be the relative efficiency of different lights in penetrating fogs. It is a point open to the observation of every one of us, that the electric light upon the Thames-embankment exhibits no more power in penetrating fogs than gaslight. The reason of this is extremly simple. Light, as I have previously explained, is due to the undulation of matter. There are waves and waves; some like the mighty ocean swell, tossing the *Great Eastern* like a cork in a basin; others are reflected from the side of the cork, as the billows of a storm are tossed back by a solid pier. The colour of the sky is due to the reflection of the tiny blue waves, by excessively minute material particles floating about. The red sky at night is due to the unimpeded transmission of the larger red waves, the smaller ones being checked; hence the dull red of the round sun in a mist, and the destruction of the smaller rays of the electric light, which lend it that bright and brilliant violet tint in clear weather. For the same reason that the penetration of the electric light is no greater than gas, its illuminating power in its immediate neighbourhood is more. For these small rays which had been checked by material particles from penetration are reflected back to the immediate neighbourhood of the light. There is a great difference between the quantity and the intensity of light. There may be light of very low intensity, but yet of such large quantity as to penetrate to a considerable distance. A ship on fire at sea, for instance, is seen to an enormous distance; and it must not be forgotten that the law of squares, by which the relative intensity of light is determined, is true only for points; it is not true for surfaces. A large flame of gas, though its intensity is so much less, may be as luminant as a point of electric light. Beacon fires, though of very low intensity, are visible very far. In fact, if we increase the luminous area as we recede from it in proper ratio, we shall maintain the same amount of illumination; hence the great failure of photometric measurements to which I have

alluded. A photometer measures the intensity of light, not its quantity.

It is important to acquire some experience from the actual users of the electric light, and to know what amount of business has already been done. For instance, there are nearly 300 Gramme machines in use in England generating light. There are many more Siemens's, while the Brush people have already installed many machines and lights.

The Trinity-house, who have applied the electric light to lighthouse purposes, have at present confined its use to Souter Point, South Foreland, and the Lizard. They find that the expense involved in the installation of the light is very considerable, and it cannot be adopted without very strong and powerful reasons. Perhaps the greatest extension in the use of the light has been for naval purposes. Nearly all our present ironclads are supplied with the electric light. The last addition to this list, the *Inflexible*, will have no less than two Brush machines, each producing sixteen lights. These machines will be arranged to work together or separately. There will be lamps in the citadel, in the engine and boiler-rooms, in the steering platform, below the torpedo department, in the magazine and shell-rooms; they will be used for buoy lights and mast-head lights, and probably, as there will be plenty of accommodation on board for the production of electricity, the cabins will be lighted with some incandescent lamps. The *Minotaur*, again, is fitted with sixteen Brush lamps; and, in fact, for torpedo purposes, the light is not only useful, but absolutely essential. Last year I had the pleasure of spending some time in the Mediterranean on board a ship laying a submarine cable between Marseilles and Algiers. Our operations were carried on by night as comfortably as by day, by the aid of the electric light.

Libraries, again, have become a useful field. Reading by gaslight is irksome; reading by the electric light is simply delightful. The Picton Gallery at Liverpool has been so lit for a long time, and the British Museum is now permanently illuminated by five arc lights, which fully answer the purpose. This has enabled the authorities to keep the reading-room open daily through the winter till seven o'clock, and only on one day (and that within a short time of the hour of closing) have the lamps failed, the failure being due to a want of proper fuel for the engines. At South Kensington 32 Brush lights are used with great success, and afford every satisfaction, not only as a luminant, but in an economical sense.

Railway stations are gradually adopting the lights. The Liverpool-street Station of the Great Eastern, the Paddington Station of the Great Western, the Waterloo-bridge Station of the London and South Western, the Charing-cross Station of the South Eastern, the Bricklayer's Arms (Goods) Station of the South Eastern, are being practically and effectively lit, and the St. Enoch's and Queen-street Stations at Glasgow, as well as the Victoria Station at Manchester, are equally successfully being lit.

Again, we find seaside resorts availing themselves of it for the illumination of their parades. Blackpool, for instance, has, with great enterprise, lit up the whole of its parade and piers with great success.

The new Albert Docks on the Thames, the Alexandra Dock at Newport, the Me[illegible]
Liverpool, are all spreading the us[illegible]
with considerable speed. I was sur[illegible]
to find the Belle Vue Gardens at [illegible]
pleasure resort that reminded me ve[illegible]
old Surrey Gardens we used to ha[illegible]
where, without any expert assista[illegible]
managers, the Brothers Jennison, [illegible]
several lights themselves, and ha[illegible]
neither trouble nor difficulty in the [illegible]

It would be impossible to make a[illegible]
the numerous works, mills, dye w[illegible]
have been supplied with lights work[illegible]
The Iron Works at Barrow, for [illegible]
very extensively employed it; w[illegible]
office was probably the first place [illegible]
inaugurate the introduction of th[illegible]
for such purposes. Shops and wa[illegible]
parts of the country are now b[illegible]
Whiteley's, Shoolbred's, Nicholl's, [illegible]
Crocker's warehouses in Friday-st[illegible]
other places, and now we find th[illegible]
rating the illumination of their st[illegible]
spaces. I never pass that wretch[illegible]
that indicates the site of old Temp[illegible]
wishing that the heraldic beast th[illegible]
were removed, and supplanted b[illegible]
bronze pillar 30 or 40 feet hi[illegible]
miniature sun. It would not [illegible]
memorial more ornamental, but it [illegible]
useful as well.

One of the most useful purpose[illegible]
light has been applied, is that o[illegible]
Not only are pictures taken by [illegible]
wretched fogs of winter, that qu[illegible]
actinic power of sun rays, but it is [illegible]
large extent in carrying out what [illegible]
Woodbury process. The electric [illegible]
powerful as sunlight, *i.e.*, it does n[illegible]
the same rapidity. Electric light [illegible]
three times as long to print gela[illegible]
the Woodbury process, as the su[illegible]
Lock and Whitfield assure me th[illegible]
know what they should have done [illegible]
sunless winter without its aid. [illegible]
posure is for one hour in the sun, [illegible]
in the electric light, is a matter of [illegible]
if the quality of the results are si[illegible]
however, has an advantage, due, d[illegible]
greater quantity of light that it em[illegible]

Perhaps, however, the most int[illegible]
ance from a scientific rather tha[illegible]
point of view, is the application, [illegible]
Chairman, of this light to horticu[illegible]
He has found that it fulfils all the r[illegible]
the growth of plants and ripening [illegible]
he has at his country seat, near T[illegible]
carried on a very large series of ex[illegible]
have created quite a sensation i[illegible]
world.

Notwithstanding these great [illegible]
use, it must not be forgotten t[illegible]
light has its defects and its disadv[illegible]
not gold that glitters. The intens[illegible]
it emits are troublesome. The uns[illegible]
light is at times wearisome. The [illegible]
purities in the carbon and irreg[illegible]
current produce is tantalising, [illegible]
has an unfortunate habit of mi[illegible]
when it is most wanted. More [illegible]

durability remains yet to be solved. Many tried it and abandoned it. In some cases economy is unquestionable; but there are where careful persons have shown that gas, ards economy, surpasses it. It is question- hether, in some cases, the electric light does the eye. The experience, however, of ders of the British Museum is entirely in its . Nevertheless, I have myself suffered much he light; true it was in experimentation, same thing might have happened with this light; but rumours do exist that eyes affected, and probably sufficient time yet elapsed to solve this question. The produces, also, nitrous acid and other gases, as is shown in the condition of ps. The incandescent lamp, is, however, this trouble. The powerful currents that cannot be carried over buildings and ithout incurring danger from fire and to has been proposed to utilise the electric coal mines, but, to my mind, one might as train of gunpowder along a mine gallery, all a dangerous one, as a wire conveying erful currents of electricity as a light ess that wire be most carefully protected. urbance due to induction I have already Nevertheless, in spite of all these defects, as great and manifold advantages. The of a well-lit room is simply enchanting. of the light for the transaction of busi- election of colours, and the ordinary ations of life, is simply superb. The of the light is one of its great merits. It noke; but probably its greatest advan- be found in the influence it exerts on e all know that the air is vitiated to a ent, by the mixture of carbonic acid l it has been well shown that to be con- health there should be not more than s of carbonic acid in ten thousand air. When the proportion reaches ten ten thousand, the action of the heart is When this proportion runs up to from thirty volumes in ten thousand, occur, and in higher proportions, rheu- l bronchitis are the consequences. Now, nd cubic feet of fresh air per hour per , consuming three feet per hour, are maintain your health; in fact, in our eries at the General Post-office, we to three million feet of fresh air per vide a healthy atmosphere. The electric s away all the necessity for this venti- does not vitiate the air. We have Glasgow, where we have applied the it, that all these causes of trouble have ealth has been engendered, more work ot out of men, and, in point of fact, the of others shows that the electric light r itself even in the increased work that ined out of labour in consequence of ot only is the health of the subject im- ; men are able to do more work in a from the influence of this pure light the impure light of gas. We still want ombined with steadiness and durability. ces made have not been so much in m, as in the improvement of details, and knowledge of electrical measurements and of the relations that exist between electricity, heat, and light. Electricity as a substitute for gas is not a delusion; it is practicable. It supplies a real want; but for domestic purposes it is at present a luxury, and an expensive one. Predictions as to its grand future have not yet been fulfilled. The public have shown themselves remarkably sensitive to its influence on gas. Nevertheless, it has a bright future before it, and, though the poet might have said—

> "It was a phantom of delight,
> When first it beamed upon my sight;
> A lovely apparition sent
> To be a moment's ornament."

—if he had lived in the present day, he would have considerably added to the period in which he estimated the electric light to be an ornament.

DISCUSSION.

The Chairman, in moving a vote of thanks to Mr. Preece for his valuable paper, said that gentleman had passed the whole subject of electric lighting in review, in a manner which must have struck home to the minds even of those among the audience who had not before given particular attention to the subject. He had followed the energy pent up in the coal in former ages through its transformations in the steam-engine and the dynamo-machine, where it was manifested as an electric current, passing through the conductor into the lamp regulator, where, through the resistance offered to its passage, heat was again generated, being the very form of energy with which they started, with the difference, however, that the heat produced in the electrodes of the lamp was of a much more intensified nature than the heat developed by the combustion of the coal. Hence, after all, electric lighting meant nothing else but carrying energy from the coal to the carbon in the lamp. But simple as the problem appeared when thus put, it had required the combined ingenuity and labour of philosophers and of practical electricians, extending not indeed over centuries but over decades; and even now a point had only been arrived at where it could be said that electric lighting was feasible. At the present day, advances were made more rapidly than had ever been the case before, and before long it might be possible to say that electric lighting was an accomplished fact. The great experiment soon to be made in the City of London would be an event of the greatest importance, and the greatest city in the world was now leading the way in utilising this new agency in a way which would leave no doubt as to its efficacy. Photometry, the sub-division of the electric light, and various applications of electricity, had also been touched upon in the paper, and though most of the propositions put forward in it would be accepted by all who understood the subject as natural facts, still, naturally enough, in so new a science, there were other points which were controvertible, and which he (the Chairman) would like to argue with Mr. Preece, but that he feared to try the patience of the meeting. They had sometimes argued questions very strongly, but had always been very good friends afterwards. If he had understood aright, Mr. Preece hoped, and great philosophers had entertained the same hope, that the divided light would ultimately equal the centralised light in economy. He begged to differ from that conclusion. Divided light meant light brought nearer to the eye, and the eye could not bear a light of such intensity in close proximity as it could bear at a distance. Mr. Preece had very well said that light was nothing but heat of the intensest kind. In order to have the greater number of light rays over heat rays emanating from a centre, it was necessary that the temperature should be raised to the utmost attainable point; even in the

electric arc, then burning in the lamp before them, probably nine-tenths of the rays emanating from that centre were not luminous, but heat rays, otherwise, even with the lamp so far removed, they would not be be able to bear the light. Although he believed that divided lights would be very largely used, and with great effect, where centralised light was not applicable, yet it might well be argued from *à priori* reasoning that a central light must be always more economical than a divided light. With regard to his own experiments, mentioned by Mr. Preece, he had carried them on since last year for the purpose of promoting the growth of plants by the electric arc, with the object, not so much of ripening strawberries and cucumbers sooner than his neighbours, but of ascertaining to what extent it was possible to produce rays capable of acting in substitution for solar rays, and also to what extent plants could be accustomed to bear this agency without intermission. He hoped to be able to lay further results before the scientific societies before long. One point of interest was the fact, that the steam-engine he employed to produce the electric light at night, afterwards yielded, through condensation of the waste steam, the heat for the green-houses, so that the electric light did not add materially to his coal consumption. Having to keep a fire under the boiler day and night, he thought it a good opportunity for utilising the steam power during the daytime, and he had done so by means of leading wires from the dynamo machine, to another similar machine at the farmstead working a chaff-cutter, to another for working a pumping engine nearly half a mile distant, and to a saw-bench in another direction; so that while doing its work near the green-houses, the engine was also cutting chaff and wood in one direction, and pumping water in another, and he hoped yet to make it available for ploughing the land also. Those facts showed that this mode of energy was extremely pliable, and could with great ease be made available at a distance. It is also important to remark that no other electrician was employed to keep the apparatus in order than the head gardener, without certainly any special training for this work.

Mr. Cromwell Varley, F.R.S., had not paid much attention latterly to the application of the electric light, and the very full remarks already made left him very little indeed to say. The reason why lights placed one after the other in one circuit were not so economical as the concentration of the entire power in one lamp placed at a great elevation, was that a considerable amount of power was required to heat the carbon sufficiently to make it glow, and that power was all dead loss. Every particle of power employed beyond that amount would heat the carbon more and more, and so a greater amount of heat would be obtained when the entire energy was concentrated in one lamp and one carbon, and a much greater incandescence than when so much power was spent in heating, at different parts, a great number of lamps. If it were possible to have stretched along a street one long conductor of fine wire of such a character that it would bear a very much greater heat than carbon, and could be made incandescent, of course the most uniform and perfect light would be obtained. Failing that, the next best thing was to get a comparative equality by using one light at a greater elevation. But in the City of London, where the atmosphere was loaded with particles of carbon which practically acted in such a way as to reduce the light from white to red, he was afraid that this mode of illumination would be no more successful than that of the sun on a foggy day.

Mr. Swan remarked that Mr. Preece had expressed some doubt as to the economy of light produced on the principle of the incandescence of a very thin conductor of carbon, apparently grounding his opinion upon Sir William Armstrong's calculations, but if the figures given by Sir W. Armstrong were worked out, they would show that the light obtained by means of the incandescent l be divided to any extent into small portions, might be conducted to any place where it ticularly wanted; and considering the adv distributed light, even taking the figures of Si Armstrong, it could be obtained with a suffici of economy for practical purposes. And furt Sir William Armstrong's experiments were much greater degree of economy had been rea might say, without fear of contradiction, that twice the amount of light could be obtained by expenditure of power; it would be fairly w mark to say that a light of 250 candles coul obtained by an expenditure of one horse-pow sidering how very small a quantity of required to develop the mechanical for would be sufficient—a very satisfactory stan tributed or divided light was afforded for Varley's illustration of the ideal mode of dis the light along a street, namely, by having a wire made incandescent throughout its entir had suggested to his mind a very strong arg favour of the divisibility of the electric lig principle of incandescence, for it appeared al evident that it would require no more m power, and would, therefore, cost no more, to h extending the length of a street, than it wou the same wire if it was cut into a number of sm separated by means of conductors of a si absorb any very large amount of the power. Varley's straight wire were cut up into— pieces, the same power would evidently be r produce the light, and the economy of thi principle of incandescence, appeared to be, self-evident.

Sir Charles Bright called attention to advance made in electric lighting ever since Exhibition, and especially in the improvemen details in several of the dynamo-electric Great improvements had also been made in t kinds of arc and incandescent lights which introduced. Mr. Preece had calculated from of coal, which was the common unit in calcu power expenditure, but he hoped the day w when calculations of the cost of the electric li not be entirely based upon the consumption of bustible material. When the system beca organised, the power necessary for the ele might be derived from the watersheds of Eng so the cost of the light, at all events, to within reach of such power, would be red much in comparison with the cost of coal. of tides and of waterfalls might be hereafte lated for producing light for the whole count the expenditure of one pound of coal, and n obtaining light during the night, but for man of power for daily application.

Mr. Phillips (nephew of Mr. Brush) gave a bri of the progress of the electric light in Americ course of the last two years, about 6,0 lights had been introduced there, many of th terior illumination in factories and depôts. ing of streets and open spaces in that wa been very widely adopted. At Wabash, in of Indiana, the whole town was completely four lights, placed on the dome of the Court- yielding a better illumination than could be o more than five times the expenditure in gas light the time could be distinguished upon half a mile distance; and within a radiu 400 feet the smallest print used in newspape distinctly read. Those four lights required power, and were maintained at a cost, includi on the investment, of not more than 1,100 d little over £200 per annum. In New York was to be extended over an area of a square

hts would be thereby introduced for street Montreal Docks were illuminated by 17 circuit of 17,000 feet of wire, and operated dynamo-electric machine, absorbing pro-teen horse-power. Various factories in ites were also lit in the same way; and as or £500 had been invested by more than ctric light apparatus. Upon that invest-se about £300 per annum was being saved t of gas, so that in a little over a year, the paratus would be paid for in the money five times greater volume of light, and one . all the colours of the goods to be distin-prevented vitiation of the atmosphere in is, which was, of course, a matter of very ation. Wabash contained 5,000 inhabi-ended over a radius of about five furlongs. e light threw shadows of some density, he experience of perfectly unprejudiced ven in the shadows the light was con-, in fact, much more than could be found ween two ordinary street gas-lamps.

on, in reply to Mr. Preece's remark that a power could, with difficulty, be realised ersons, suggested that an idea of it could rom the fact that, by one of Dr. Siemens's 6,000 power candle-light, elevated 60 feet vement, a *Globe* newspaper could be read at a distance of 80 yards, and much more than under a gas-jet 15 feet above the Such lights were peculiarly valuable for docks and other large areas, as watchers ild perceive any tampering with the goods us of 400 feet. Probably the light was a e more economical than gas, and, indeed, of gas-jets necessary to properly light ast areas could hardly be calculated. he lights on the Thames Embank-threw out highly refrangible rays, soon ible in fogs, but that was not the case amps as were then burning in the room. he highly refrangible rays given out by f ceased to pass through a fog, the rays om the incandescent carbon points would considerable distance. From experiments, that a powerful light, 80 feet high, would, ry dense fog, give a good light 60 or 80 it.

e, in reply, said the difference between the d himself was but small, and one merely in ically, he agreed with Dr. Siemens, that there as when the problem regarding distributed ved, and where it was more economical and centralised light. He might take exception nents of Mr. Varley and Mr. Swan, as he hat it was not even theoretically possible a wire in a state of incandescence along f it were practicable to do so, it would sible to divide the wire into a number of is, but while it was found to be impossible to keep 30 or 40 of these lights going, it qually impossible to maintain a wire in incandescence that would illuminate a 40 yards long. At present the idea of the light by breaking it up into small jets s quite out of the question. Mr. Swan's ween the two occasions he had visited London far apart—in raising the illuminating power ps from 140 to 250 candles, showed the was making, and that he was working in rection. Mr. Phillips's account of what had in the town of Wabash and elsewhere in as extremely interesting, but the town was a and it would be long before we should be our present apparatus, to produce a light the top of St. Paul's, would do much more than illuminate the immediate neighbourhood of the cathedral. He concluded by requesting the meeting to join in a cordial vote of thanks to Mr. Stevens, of Basingstoke, Mr. Hendricks, Mr. Joel, Mr. Swan, Mr. Crompton, Messrs. Siemens and Co., the British Electric Light Co., and several other gentlemen and companies who had kindly furnished lamps, diagrams, and apparatus for the purpose of the lecture.

The meeting was then adjourned.

During the first part of the meeting, the room was illuminated by a Siemens lamp and several Joel lamps. During the latter part it was lighted by a number of Swan lamps and a Brockie lamp. The current was supplied by a large and an ordinary-sized Gramme machine, and by a Bürgin machine. These machines were driven by the Robey 10 h.p. engine which has been used during the past fortnight for the illustrations for Professor Adams's lectures and Professor Perry's paper. The Society is indebted to the proprietors of the above lamps, machines, and engines, for the loan of them.

APPLIED CHEMISTRY AND PHYSICS SECTION.

Thursday, March 24. 1881; Latimer Clark, F.R.G.S., in the chair.

The paper read was on "The Future Development of Electrical Appliances," by Prof. John Perry. The paper will be printed in a future number of the *Journal*.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at eight o'clock:—

April 6.—"The Discrimination and Artistic Use of Precious Stones." By Professor A. H. Church, F.C.S. Sir Philip Cunliffe-Owen, K.C.M.G., C.B., C.I.E., will preside.

April 27.—"Five Years' Experience of the Working of the Trade Marks' Registration Acts." By Edmund Johnson.

May 4.—"Buying and Selling; its Nature and its Tools." By Professor Bonamy Price, M.A. Lord Alfred S. Churchill will preside.

Foreign and Colonial Section.

Tuesday evenings, at eight o'clock:—

April 5.—"Canada; the Old Colony and the New Dominion." By E. Hepple Hall. John Rae, M.D., F.R.S., will preside.

May 10.—"Trade Relations between Great Britain and her Dependencies." By William Westgarth.

Applied Chemistry and Physics Section.

Thursday evenings, at eight o'clock:—

April 28.—"Impurities in Water, and their Influence upon its Domestic Utility." By G. Stillingfleet Johnson, F.C.S.

May 12.—"Recent Progress in the Manufacture and Applications of Steel." By Prof. A. K. Huntington.

May 26.—"Telegraphic Photography." By Shelford Bidwell. Prof. W. G. Adams, F.R.S., will preside.

Indian Section.

Friday evenings, at eight o'clock:—

April 29.—"On Indian Building Acts." By General Maclagan, R.E.

May 13.—"Burmah." By General Sir Arthur Phayre, G.C.M.G., K.C.S.I., C.B.

Members are requested to notice that it may be necessary to make alterations in the dates of the above papers.

Cantor Lectures.

Monday evenings, at eight o'clock:—

The Fourth Course will be on "The Art of Lace-making," by Alan S. Cole. Four Lectures.

Syllabus of the Course.

Lecture I.—April 4.

Introduction. Early forms of twisted, plaited, and looped threads. Ornamental borders of Assyrian, Greek, Roman, and other costumes. Sumptuary laws. Venetian books of patterns for embroidery and lace. Flanders a centre of linen trade of Europe. Spanish and French importations of early lace. Effect of production of machine-made lace upon production of hand-made lace.

Lecture II.—April 11.

Needlework upon a material. Needlework upon separate threads. Venetian needle-point lace. Needle-point and tape lace. French needle-point lace-making centres. English and Flemish needle-point lace.

Lecture III.—May 2.

Fringes. Twisted thread-work in England in the 15th century. Early designs for plaited and twisted threads. Italian, Flemish, French, and English pillow lace. Laces of primitive design.

Lecture IV.—May 9.

Resumé as to styles of design in hand-made lace. Traditional patterns. Sketch of the development of inventions for knitting and weaving threads to imitate lace. Differences between machine and hand-made laces. Modern hand-made laces at Burano, Bruges, Honiton, &c.

This course will be illustrated by specimens of lace. Diagrams and photographs enlarged will be shown by means of the lantern and oxyhydrogen light.

The Fifth Course will be on "Colour Blindness and its Influence upon Various Industries," by R. Brudenell Carter, F.R.C.S. Three Lectures.

May 16, 23, 30.

MEETINGS FOR THE ENSUING WEEK.

Monday, April 4th ... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. Alan S. Cole, "The Art of Lace-making." (Lecture I.)

Farmers' Club, Inns of Court Hotel, Holborn, W.C., 4 p.m. Mr. T. Bell, "The Agricultural Returns for 1880, and their Teaching."

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Society of Engineers, 6, Westminster-chambers, 7½ p.m. Mr. Perry F. Nursey, "Illumination by Means of Compressed Gas."

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 7, Adelphi-terrace, W.C., 8 p.m. Prof. Balfour Stewart, "The Visible Universe."

Tuesday, April 5th ... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Foreign and Colonial Section.) Mr. E. Hepple Hall, "Canada; the Old Colony and the New Dominion."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. E. A. Schäfer, "The Blood." (Lecture XII.)

Central Chamber of Agriculture (at the House of the Society of Arts), 11 a.m.

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. B. Baker, "The Actual Lateral Pressure of Earthwork."

Pathological, 53, Berners-street, Oxford-street, W., 8½ p.m.

Biblical Archæology, 9, Conduit-street, W., 8 p.m. 1. Mr. Ernest de Bunsen, "The Times of Israel's Servitude and Sojourning in Egypt." 2. Prof. Eb. Schrader, "Abydenus and the Book of Daniel."

Zoological, 11, Hanover-square, W., 8½ p.m.

Wednesday, April 6th ... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Professor A. H. Church, "The Discrimination and Artistic Use of Precious Stones."

Geological, Burlington-house, W., 8 p.m. 1. Mr. Frank Rutley, "The Microscopic Structure of Devitrified Rocks from Bedgellert and Snowdon." 2. Mr. Frank Rutley, "The Microscopic Characters of the Vitreous Rocks of Montana, U.S." 3. Mr. T. Mellard Reade, "The Date of the Last Change of Level in Lancashire."

Entomological, 11, Chandos-street, W., 7

Pharmaceutical, 17, Bloomsbury-squar Mr. A. W. Gerrard. "'Wanika,' a ne Poison, its Composition and Propertie

Royal College of Physicians, Pall-mall E (Lumleian Lectures.) Dr. Southey, "I (Lecture II.)

Archæological Association, 32, Sackvill 1. Mr. Thomas Morgan, "Remarks Mosaics at Brading." 2. Mr. J. T. Irvi Cathedral of Bath, discovered durin 1869."

Obstetrical, 53, Berners-street, Oxford-s

Institution of Naval Architects (at th Society of Arts), 12 noon. 1. 2. Election of Officers and Council. President. 4. Mr. J. D'A. Samuda, *Brown*, Argentine cased Corvette, a Steel Hulls and Steel-faced Armour Ships." 5. Mr. W. Parker, "On Behaviour of Steel used in Boilers, Yacht *Livadia*." 6. Mr. J. R. Raven creasing use of Steel for Shipbuild Engineering."

Thursday, April 7th ... Institution of Naval A House of the Society of Arts), W. H. White, "The Stability of Ships." 2. Mr. James Hamilton, " Paddle Steamers, and their Position Wheels." 3. M. Marc. Berrier Fo of Mild Steel for Shipbuilding in t yards." 7 p.m. 1. Mr. W. Denny, cation in Naval Architecture." 2. "Crank Shafts." 3. Mr. C. Stromeye of the Cut Off and Length of Strok of Steam Engines."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½

Linnean, Burlington-house, W., 8 p.m Cobbold, "The Parasites of Elephant "The Indian Species of Primula. Sorby, "The Green Colouring of the 4. Dr. W. A. Herdman, "Individual Bronchial Sac of Ascidians."

Chemical, Burlington-house, W., 8 p.m

Society for the Encouragement of Fine street, W., 8 p.m. The Second Conv

South London Photographic (at the Society of Arts), 8 p.m.

Royal Institution, Albemarle-street, W. Statham, "Ornament Historically a sidered." (Lecture IV.)

Inventors' Institute, 4, St. Martin's-pla

Civil and Mechanical Engineers, 7, West S.W., 7 p.m. Mr. B. Haughton, "R

Archæological Institute, 16, New Burl 4 p.m.

Friday, April 8th ... Institution of Naval House of the Society of Arts), 12 H. White, "The Rolling of Sailing S E. Froude, "The Leading Phenom making Resistance of Ships." 3. M "Freeboard and Displacement in Rel Ships among Waves." 7 p.m. 1. "The Imperial Russian Yacht *Liva* Reed, "The Injuries Sustained by t Bay of Biscay." 3. Mr. J. Biles, Deduced from Curves of Resistance. Hall, "Notes on Screw Propulsion Archer, "Shipbuilding a Thousand Y

Royal United Service Institution, Whit Captain J. C. R. Colomb, "The Ne Intelligence Department."

Royal Institution, Albemarle-street, Tyndall, "Conversion of Radiant He

Astronomical, Burlington-house, W., 8

Quekett Microscopical Club, Universi 8 p.m.

Clinical, 53, Berners-street, W., 8½ p.m

New Shakspere, University College, W. Constance O'Brien, "Shakspere's O Emma Phipson, "Was Shakespeare

Royal College of Physicians, Pall-mall (Lumleian Lectures.) Dr. Southey, " (Lecture III.)

Saturday, April 9th ... Ladies' Sanitary A House of the Society of Arts), 5 Richardson, "Domestic Sanitation or (Lecture VIII.)

Physical, Science Schools, South Kensin Dr. J. H. Gladstone and Mr. Tribe, " Electrolysis."

Royal Botanic, Inner-circle, Regent's-p

Royal Institution, Albemarle-street, W R. Haweis, "American Humorists."

Geologists' Association, University Coll Visit to British Museum (Natura Kensington, under the direction of ward.

L OF THE SOCIETY OF ARTS.

No. 1,481. Vol. XXIX.

FRIDAY, APRIL 8, 1881.

...tions for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

CANTOR LECTURES.

...t lecture of the fourth course was de-...a Monday, 4th inst., by ALAN S. COLE, ...Art of Lace-making." Enlarged photo-...various kinds of lace alluded to in the ...re shown by means of the lantern and ...gen light.

...ures will be printed in the *Journal* during ...n recess.

...MESTIC ECONOMY CONGRESS.

...d meeting of the General Committee ...the Society of Arts on Wednesday, 6th ...n the following ladies attended:—The ...Leeds, the Countess of Airlie, Viscountess ..., Lady Arthur Russell, Dowager Lady ...Alderley, Lady Jane Stewart, Lady ...E. Kennedy, Lady Reay, Hon. Mrs. ...ady Cole and Miss Cole, Lady Verney, ...Bayley, Miss Rose Adams, Mrs. Bartley, ...er, Mrs. Buckton, Mrs. Burke, Mrs. ...rs. Cotton, Mrs. Grenfell, Miss Mary ...iss Frances Martin, Miss H. A. Martin, ...ottiswoode, and Miss R. Spottiswoode, ...Webb, Secretary of the Congress. Lord ...urchill, Sir Henry Cole, K.C.B., Major-...tton, R.E. C.S.I., and the Rev. Newton ..., members of the Executive Committee, ...resent.

HOUSE SANITATION.

...ncil offer the following Medals for the ...ary Arrangements in Houses built in ...polis, the plans of such arrangements to ...d in the Society's Rooms, Adelphi, in ..., and to be sent in on or before 12th ...:—

...ilver Medal for the best sanitary arrange-...ried out and in satisfactory working, ...let out in tenements to artisans, for ...ekly rental is paid.

...Silver Medal for the best sanitary ...nts, in actual working, in a house of the yearly rental of £40, or less, to about £200 in value.

3. One Silver Medal for the best sanitary arrangements, in actual satisfactory working, in a house of the yearly rental value of £200 and upwards, to any amount.

4. The houses must be open to the inspection of the Judges, who, in considering their award, will be guided by the suggestions of plans for main sewerage, drainage, and water supply, made under the Public Health Act, 1875. The houses must have been in actual occupation within the last three months, and a Certificate must be given by the occupiers, on a printed form, stating the satisfactory working of all the sanitary arrangements, such form to be obtained at the Society of Arts.

5. The houses may be old, fitted with modern sanitary arrangements, or may be new. They must be within the metropolitan area of the Board of Works.

6. The sanitary arrangements must include the conditions for good water supply, drainage, warming, and ventilation of the house, and precautions taken against frost.

7. The medals may be awarded to the occupiers of the houses, or the lessees, or the owners.

8. The plans must consist of a ground plan and sections, to the scale of not less than one inch to five feet; details of not less than one inch to the foot. The plans may be accompanied by specifications.

9. The names of the architects, surveyors, or sanitary engineers who directed the sanitary arrangements should be given, and Certificates will be awarded to those whose plans obtain the Medals.

PROCEEDINGS OF THE SOCIETY.

EIGHTEENTH ORDINARY MEETING.

Wednesday, April 6th, 1881; Sir PHILIP CUNLIFFE-OWEN, K.C.M.G., C.B., C.I.E., Member of the Council of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Beattie, William, London and South Western Railway Works, Nine-elms, S.W.
Cockburn, James, 11, Heathcote-street, Mecklenburgh-square, W.C.
Crossley, John Thomas, Q.C., 91, Cheyne-walk, S.W.; 4, New-square, W.C.; and Junior Athenæum Club, S.W.
Gibson, Joseph F., Clovelly, Woodchurch-road, West Hampstead, N.W.
Goodwin, Thomas, 12, Southwark-street, S.E.
Law, James, 544, Oxford-street, W.

Lovett, William John, Carver-street Works, Birmingham.
Lyell, Francis Horner, F.R.G.S., Nettlestone, Widmore, Bickley, Kent.
MacGregor, Alexander, M.A., 6, Charles-street, Berkeley-square, W.
Powell, Frederick, F.R.G.S., Bakewell, Derbyshire.
Pupikofer, Oscar, The College, Matlock, Derbyshire.
Stubbs, William Henry, 3, Winton-square, Stoke-on-Trent.

The following candidates were balloted for, and duly elected members of the Society:—

Atkinson, John, Tosti, Falsgrave, Scarborough.
Bacon, George Washington, F.R.G.S., 127, Strand, W.C.
Black, William, South Shields.
Lorimer, William, Messrs. Dübs and Co.. Glasgow.
Russell, William J., Ph.D., F.R.S., 34, Upper Hamilton-terrace, N.W.

The paper read was—

THE DISCRIMINATION AND ARTISTIC USE OF PRECIOUS STONES.

By Professor A. H. Church, F.C.S.

It was not without set purpose that I associated a scientific and an artistic conception in the title of this paper, for I am desirous of making a contribution, though it be but a small one, to the intelligent study and intelligent employment of precious stones. And I am convinced that some acquaintance with the less obvious qualities of well known gem-stones, and with the distinguishing characteristics of those species which remain practically unrecognised and unappreciated, will help forward the improvement of the jeweller's art in this country. Most admirable and pleasant colour-combinations are attainable by the aid of materials which, in many cases, are now by no means costly. Curious and delicate hues, of luminous quality, and in enduring substance, may be arranged and grouped in forms of endless beauty and variety. Neither silks nor paints, nor even enamels, can ever equal the colours of precious stones in durability, or in brilliancy and pulsating variety of hue. By pointing out some of the methods of discriminating one stone from another, I hope to be able to explain the modes which I shall cite or suggest, for their artistic employment. But I hope to do more than this. For when we know something about the intimate nature of any art-material, we begin to feel a more intelligent and a more lively interest in examples of good workmanship wrought in the substance in question. Every *connoisseur* or collector of artistic objects must have shared in experiences of this kind. He may have been once quite dead to the peculiar merits of certain works—say, in bronze, not even glancing at any specimens falling in his way. Then some casual circumstance, perhaps an exciting contest for a fine piece of work at a sale between two enthusiastic collectors, or perhaps the gift of a choice specimen, may have drawn attention, I will not say to the merits of such specimens, but at least to the esteem in which they may be held. Curiosity—it may be an intelligent curiosity—is excited. Investigation, more or less searching, follows. The hardness of the metal, its *provenance*, its designer, its age, the mode of manufacture, whether by casting or ham the manner of decoration, whether by engraving, or inlaying; the colour ture of the surface, the presence or of *patina*, and not a few other p interest, constitute the materials of study. Study provokes observation, a vation study, so that before long the group of artistic bronzes exerts a kind o tion upon the new votary. If his know superficial and inaccurate, or if he be amateur or collector just because it is a fa pursuit to gather together or to admir classes of artistic objects, well, then, he really know what and why he admires. F delight him just as much as genuine works, as he is not sure that they are forgeries; has not sufficient patience for the master sufficient insight into, the characteristics productions, to discriminate them from those are false. It often happens thus with the of precious stones. He knows nothing of the elements, say, of surface lustre, and the which go to make up the *tout ensemble* of ticular gem, and is quite satisfied with a bit of paste, or a cleverly contrived No doubt, in some cases, even an keenness of vision does not suffice to guish the true stone from the false, alth the durability of the genuine specimen ultimately prove their superiority. But it difficult to learn to appreciate the peculi essential characters of the majority of the of precious stones. What I wish to comp night, has, then, not merely relation to the use and arrangement of gems, but also appreciation of their inherent characteristics at least as these affect their appearance. to sketch these characteristics, and then to pose them into pictures. For this purpose set down, in some sort of order, the most v optical distinctions belonging to precious arranging these under the general he "Surface" and "Substance":—

1. Plane	Form ..	Sur
2. Curved		
3. Metallic	Lustre..	
4. Adamantine		
5. Resinous		
6. Vitreous		
7. Waxy		
8. Pearly		
9. Silky		
10. Transparent	Light ..	Sub
11. Translucent		
12. Opalescent		
13. Chatoyant		
14. Opaque		
15. Prismatic	Colour..	
16. Monochroic		
17. Pleochroic		
18. Fluorescent		

I will now proceed to give some example use of such a tabular statement as this. ring to the shape of stones, we note the boundaries are either plane or curved. Now want to use curved surfaces, like those of we shall find that it will not answer to a

ı other curved surfaces, like those of the ɴ moonstone; and especially is this the e the size of the stone as well as the of the curved surface is nearly identical; ier result will be attained by combining stone with one having a curved surface. ı, citing an example from the series of expressing qualities of surface, it ɔund that gems having an adaman- assort better with those which pre- ɜs brilliant surface known as waxy, do with those which show a nearer to the adamantine surface, and which resinous. The diamond and the jargoon rove or bring out each other's qualities, ve too many points in common; but the ccords well with the pearl, and the jar- the turquoise, that is, the adamantine early, and the resinous with the waxy. ɴow, into the substance of stones, rather eir surface, their relations to the trans- colourless light furnish many illustra- se and unwise, or effective and defective ns. For example, chatoyant stones, like do not associate well with translucent the chrysoprase and the chalcedony— cency of the latter confuses, because it too closely the chatoyancy of the ut transparent stones accord well those which interrupt the passage ɔy such internal reflections. The ı this account, combines admirably with e and the pearl, but it affords too strong especially when of large size, with the o associate pleasantly with this nearly ıe. From amongst the qualities per- the colour of stones, examples of the ıy table may be cited. When a stone fire" in it—that is, when its refractive ive actions upon light are high—and rismatic hues, then it looks best if with gems in which this property is ed. Again, monochroic stones, which ions transmit beams of the same colour, ssociated with pleochroic stones which ı or more hues, while the latter should ɔd together.

ɜ useful, as an introduction to the study ɪ precious stones, to say a few words the physical experiments by aid of ities can be best ascertained and dis- where, in fact, we cannot employ or ɜt to the eye. The materials required ɔeriments are very simple, and include— ; of mineral fragments — diamond, pinel, chrysoberyl, topaz, garnet, and be used as tests for relative hardness.

l pocket spectroscope, by which absorb- as those of the garnet and jargoon, ɔted.

roiscope, or double image prism, suit- ed, by which the pleochroism, or differ- ur in the light transmitting in different a the same stone, may be ascertained.

ls or easily fusible solids, of high specific m 2·3 upwards, by means of which the f different densities in doubtful speci- e easily accomplished.

ications of this critical apparatus to the ion of certain precious stones will be mentioned further on, in connection with particular species. But a few lists or tables of the hardness, pleochroism, and specific gravity of some of the more interesting and valuable of precious stones will be useful here. Such tables are more con- venient for practical and ready use when arranged in a kind of progressive order, such as I have adopted. The hardness assigned to the different species, or varieties, must be taken as average or approximate only. The terms used to designate the differing colours of the oppositely polarised beams in dichroic stones, are the best I could select, but refer merely to the specimens examined. The table of specific gravities contains a selection from about 200 specific gravities, taken by myself with unusual precautions.

TABLE OF HARDNESS.

Diamond	10·0	Iolite	7·3
Sapphire	9·0	Cinnamon stone	7·0
Ruby	8·8	Jadeite	7·0
Chrysoberyl	8·5	Amethyst	7·0
Spinel	8·0	Jade	6·5
Topaz	8·0	Peridot	6·3
Aquamarine	8·0	Moonstone	6·3
Emerald	7·8	Green garnet	6·0
Zircon	7·8	Turquoise	6·0
Tourmaline	7·5	Opal	6·0
Phenakite	7·5	Lapis-lazuli	5·0
Almandine	7·3		

TABLE OF PLEOCHROIC STONES.

NAME OF STONE.	TWIN COLOURS.	
SAPPHIRE, blue	Blue	Greenish straw.
RUBY, red	Aurora red	Carmine red.
TOURMALINE, red	Salmon	Rose pink.
,, brownish red	Umber brown	Columbine red.
,, brown	Greenish yellow	Orange brown.
,, green	Pistachio green	Bluish green.
EMERALD, green	Yellowish green	Bluish green.
TOPAZ, sherry	Rose pink	Straw yellow.
PERIDOT, pistachio	Sea green	Brown yellow.
AQUAMARINE, sea green	Grey blue	Straw white.
BERYL, pale blue	Azure	Sea green.
CHRYSOBERYL, yellow	Greenish yellow	Golden brown.
IOLITE, lavender	Indigo blue	Pale buff.
AMETHYST, purple	Bluish purple	Reddish purple.
TOURMALINE, blue	Indigo blue	Greenish grey.

TABLE OF SPECIFIC GRAVITIES.

Zircon:—		Spinel:—	
Jacinth (Espaly)	4·863	Indigo	3·715
Columbine red	4·705	Indigo	3·675
Green	4·691	Puce	3·637
Brown	4·696	Rose	3·631
Red brown	4·651	Puce	3·592
Brown yellow	4·620	Aurora red	3·590
Yellow	4·600	Olivine:—	
Orange yellow	4·362	Peridot	3·389
Dull green	4·020	Topaz:—	
Garnet:—		White	3·597
Red	4·059	White	3·571
Yellow green	3·854	Wine yellow	3·540
Emerald green	3·849	Tourmaline:—	
Pistachio green	3·848	Green	3·154
Cinnamon stone	3·666	Black	3·124
Cinnamon stone	3·642	Red	3·044
Sapphire:—		Red brown	3·009
Yellow	4·030	Beryl:—	
Yellow	4·006	Emerald	2·704
Blue and white	3·979	Aquamarine	2·702
Chrysoberyl:—		Blue	2·701
Golden yellow	3·840	Yellow	2·697
Yellow	3·760	Brown yellow	2·690
Brown yellow	3·734		

Quartz :—		Very dark Amethyst	2·662
Milky	2·642	Adularia :—	
Pure Rock Crystal	2·650	Moonstone	2·585
Brown Cairngorm	2·656		
Amethyst	2·659		

It has been no easy matter to decide upon the order in which the several most important precious stones should be discussed. In a chemical paper, a classification in accordance with composition would be absolutely right; while such physical properties as hardness and specific gravity might be made prominent features in the arrangement of the species in a physical paper. But as the ornamental or artistic employment of precious stones conveys primarily, if not wholly and ultimately, an appeal to the eye, it is clear that such optical properties as can be comprised in the terms colour, lustre, and light should afford the bases of our classification. On the whole, the prominent feature of precious stones is their colour, and the easiest way of considering their colour is to adopt the order of succession of the colours in the ordinary rainbow or prismatic spectrum, beginning with the white light from which they all spring.

White Stones.—The diamond naturally takes the first position if we consider its hardness, its remarkable composition, and its strong refraction and dispersion of light. Its properties, so far as they appeal to the eye, differ much from those belonging to the majority of other stones, and it forms, partly in consequence of this peculiarity, as good a border or setting to other jewels as a gold frame does to a picture. Of course much depends upon the quality of the diamond, and much upon the shape which is given to it by the lapidary. The flat plates of *lasque* diamonds, and, in less degree, the step-cut stones with broad tables, exhibit the unique and splendent lustre which is peculiar to the polished surface of this stone; these forms also permit the transparency and the total internal reflection of light to be well seen. Even the form of the diamond crystal, the regular octohedron, when its surfaces are really planes, well exhibits the transparency and reflection of the stone.

This seems the place to raise a protest, which, indeed, I have done on many previous occasions, against the ignorance and narrowness which would condemn diamonds and all other stones, irrespective of all the optical differences which they present, to be cut *en cabochon*, or tallow-topped, that is, with a convex rounded surface. A certain clique of artists and amateur writers on art insist upon all stones being cut in this way, which, in the majority of cases, is fatal to the development of those optical qualities upon which the beauty of precious stones mainly depends. Indeed, the facetting of the great majority of transparent stones is not only a necessary operation, but it should be done in strict accordance with certain rules of proportion, which may be deduced from the optical constants of the species of stone operated upon. But with pale and defective specimens, the *cabochon* form is often found more suitable than the rose, or brilliant, or stepcut; and it is the only method of showing to advantage the peculiar beauties of a large number of translucent, chatoyant, or opaque stones, like the chrysoprase, the opal, the moonstone, and the cat's-eye.

Next to the diamond, we may place the colourless zircon or jargoon, then the p the white sapphire, the white topaz, beryl. Rock crystal will come b point of beauty and brilliancy. zircon (of which a fine specimen set be seen in the British Museum Mi now at South Kensington) approach prismatic brilliancy to a diamond especially, does the rare and curious kite. There is, however, always a s in finding an appropriate use for lustrous, stones in any article of jew for personal adornment. The mor prismatic they are—the more they diamond in fact—the less available a usual purpose to which gems are pu are peculiar qualities in these sto not be lost to artistic employment stones in question were judiciously materials which would prevent th taken for diamonds. A white diamor or never be bordered by green to these stones would form an agreeabl with a white zircon, a phenakite, or In the sapphire there is usually picion of milkiness, and in the a cool greyish tint, which preven from resembling the diamond to be taken for imitations of th many of these colourless stones, no and rock-crystal, in all probabi appropriately used when set as bo and other large pieces of metal-wor in the form of plaques for engravi It is scarcely necessary to justify these minerals, and this is not th upon the question, particularly as rather wide use of the term prec able to include these materials, and which I shall have to speak pres precious stones. Of two other w employed in jewellery, the moon pearl, a few words may be in The moonstone forms an excell in many combinations for the does not associate quite so well with the diamond. With deep-thysts, spinels, and tourmalines, gems look more refined than the m these stones, which fetch a shillin only, should always be accurate highly re-polished before being use are too irregluar, and their surface as imported from Ceylon, to show light sheen with half its intensity, passed again under a careful lapida improvement thus effected is marvel of the pearl, whether its "orient" b prismatic hues, or whether it be white merely, is too well known to named in this connection. But I m to say one word in deprecation of t expenditure of time, of ingenuity, materials, which the attempt to conv lar pearls into structures resemblin often caused. The result is near unhappy.

Red Stones.—The ruby may fitly before other coloured stones. sapphire, and all the transpare

m, ranks next to the diamond in hard- It is, moreover, a stone of great beauty. ly the experts in jewels are right in assign- highest value to those rubies which a "pigeon's blood" colour—this is the t hue. But the paler colours, and those erge upon pink and crimson, and even re capable of being so treated by means of n with white and black enamel, or with nes, like olive-green tourmalines, as to selves to the production of very beauti- ative effects. The great mistake com- is in the treatment of the paler rubies, e attempt to treat them in the same way per-coloured stones.

ifficult to describe the peculiar colour- of the ruby in words. In fact, our nomen- of colours is neither ample nor accurate. preciation of delicate differences between is growing, but the language by which we ur to describe the hues which we have to appreciate is either stationary, or else re- additions from time to time of unsatis- words, derived from the caprices of French The time has really arrived when a series of hues of all sorts should be con- nd appropriately named; but, in the case y, the question of pleochroism comes in, s the difficulty of describing the colour- this stone greater. There is also some 'fire" in the stone, and much internal of light, while its surface lustre lies esinous and vitreous. These four pro- e to the red of the ruby a peculiar hich the two other species of precious spinel and the garnet—which come t in colour, do not equally possess. The hich make up the colour transmitted by not differ much, but yet they help to properly cut stone, a delicate variation ch is not present in any other red stone, imitative substance. The dichroiscope, ly, never fails to discriminate between a e one hand and a spinal or a garnet on The two latter stones are, of course, the ruby, and the former is always at is, of less specific gravity. For the the whole of the corundum family of e the specific gravity of 4, and a hard- is nearly, and in some cases quite 9, on logical scale.

he happiest uses of the ruby is in the inlay, in certain gold vessels of Indian e external surface of these vessels is th a system of interlacing ridges and The rubies, generally small, oval, and hon, are set along the furrows. Thus they rotected from the chance of dislodgement, ffect they produce, of a rich deep crimson k over which a gold netting has been in perfect harmony with the materials workmanship. For, naturally, the metal pure, or nearly pure, throws a ruddy ight is reflected from surface to surface; interior of gilt vessels. The same thing the golden furrows of which we have ere the rubies seem to rest in a golden me in which the yellow, and orange, and ts, now one and now another, appear to The gold should not be burnished where much contrast between the metallic surfaces and the rubies is desired, but the stones themselves should be as brightly polished as possible, in order not only to develop the full beauty and variety of their colour, but also the very considerable surface lustre which the ruby possesses. There is another kind of Indian jewellers' work to which most of the remarks I have just made apply. A perforated plate or disc of delicate arabesque or radiated work is found decorated with ruby beads, round or oval, attached to the circumference of the ornament, or else introduced into its midst in concentric circles. Here dull, dead or "matt" gold is particularly appropriate, as affording a pleasant contrast to the rich, smooth, and soft transparency of the rubies, which, from the manner of their mounting, may be looked through. The refinement of the slender gold-work, which, in this class of jewellery, approaches the delicacy of filagree, sets off by its minuteness of detail the simpler and bolder forms of the plain, smooth, rounded stones, which give it colour and warmth. I must dwell for a moment or two upon another Eastern method of dealing with the ruby. I refer to the use of this stone as an inlay or onlay—that is, an incrustation—upon jade, both white and green. It is not so much here a beautiful contrast of colour that is attained, although the greenish grey or olive green of the jade, enhances the redness of the ruby; but it is a contrast of textures, a contrast of surfaces, a contrast of translucencies. You see but a little way into the jade, though it is illuminated by a soft diffused light; but you see through the clear deep-toned rubies, with their flashing beams of crimson.

Now compare with these examples of the artistic employment of the ruby, the ordinary mode in which this stone is set by English jewellers. Look at the half-hoop ruby ring, with five rubies well matched in colour, and graduated exactly in size, set close together in a regular row. You see, perhaps, a little speck of gold appearing here and there at each end of each stone, but nothing is made of these pieces of gold. You accept them because you know they are necessary to hold the stones in their places, but you find neither invention nor beauty in these little bits of gold claws. In fact, they are frequently prepared by the gross, ready for the mounting of any stones, provided the shape of the latter be suitable. Rubies, sapphires, diamonds, garnets, and emeralds are all set in the same way, not an attempt being made to adapt the amount of gold surface or its form to the specific nature of each gem. But why should not some variety and some appropriateness of mounting be secured for all stones? How exquisite, and yet how strong, were the gold and enamel settings of precious stones in the Cinque-cento time in Italy. Let those patrons who desire the rather barbaric splendour of masses of rubies gratify their taste by means of jewels in which the setting is not seen at all. But surely a fine stone is worthy of a fine and originally designed setting—proportioning the latter in form, in amount of work and surface, and also in colour, whether red, or green, or yellow gold, or enamel, to the shape and the hue of the stone to be set. And even small stones become quite beautiful, when arranged with taste and judgment, in accordance with the conditions I have named, and with the

further condition as to collocation of individual stones in accordance with their size and shape. In pendants, and necklets, and lockets, and brooches there is room for the expression of some definite and intelligible design. The mere alternation of rubies with diamonds in rows or chequer work may, in some instances, achieve all that is needed. But a design of more definite form may often be preferable, especially where the stones at one's disposal are of differing colours and sizes. Then one may construct a suitable bit of leafage or flowerage, duly conventionalised, in accordance with the nature of the available materials, into forms of more or less geometrical severity. It should be noted that moonstones, and white sapphires, in which there often lurks a faint opalescence, accord well with rubies; but it must be kept in mind that the size of the colourless stones which are to be associated with rubies in such designs as those which I have named, is a matter of much moment. It is a mistake to attempt to match the colourless and the coloured stones in respect of size, and generally of shape also. One should be smaller than the other. Large rubies with small moonstones, or small rubies with large moonstones, and similarly, square stones with round, and oblong stones with round, generally produce happier effects than square with square, and oblong with oblong. Pearls accord with rubies, not only by reason of their colour relations, but also on account of their shape. In the case of rubies cut *en cabochon*, brilliant-cut or square step-cut diamonds will be found to yield very satisfactory combinations. A border of small brilliants or roses is a usual and a useful mode of setting off the qualities of a ruby. The colour of a pale stone is heightened by contrast with the colourlessness of the diamonds; the richness of a rich stone is enriched, and a small stone, if surrounded by stones still smaller, becomes magnified in proportion.

Next to the ruby, amongst the red stones, comes the spinel or balais ruby, an entirely different mineral species, without any pleochroism, and inferior in hardness to the true ruby. The scarlet, aurora red, and flame-coloured spinels are the most beautiful; those which verge upon crimson, purple, and violet, looking dull and black at night, but showing very delicate and often rare hues by day. Red spinels accord well with small brilliants, or with larger pearls or moonstones. A fine aurora-red spinel looks well when surrounded with delicate foliage of white, orange, and black enamels. Step-cutting, similar to that employed for emeralds, accords best with the optical qualities of this stone. A biconvex lenticular form may be so adapted to this stone, as to throw a good deal of soft and rich colour into a specimen which would otherwise have had little beauty to recommend it. What richness of hue the finer examples of red spinel may show is to be studied in two specimens in the Townshend collection, South Kensington Museum, Nos. 1,326 and 1,327.

From spinels the passage to garnets is easy. But it is not really difficult to discriminate between the two species, even when the colours seem the same. If you have a ruby, a spinel, and a garnet together, the first will scratch the second and the second the third. The ruby will show two colours in the dichroiscope, the spinel and the garnet only one. The spinel will exhibit no black ba[...] those belonging to the red garnet, when with the spectroscope. And there is a bla[...] due to much absorption of light, in many facets of a garnet, as seen from the "table" stone, which will not be observed in the The garnet, unless of remarkable size or will hardly be deemed worthy of being [...] in the same costly way as the ruby or spinel, but it may be said that the same gene[...] ment suits all these red stones. Yet there [...] ways in which garnets have, for long and [...] places, been treated, to which I may leg[...] refer here. The plates of garnet so larg[...] in Anglo-Saxon and Celtic jewels have [...] in the majority of cases, intact to the pre[...] They afford, in their breadths of soft, ri[...] a pleasant contrast to the minute filagre[...] lated, and enamel work, with which generally associated. The other emplo[...] the red garnet (and it may be traced ba[...] earlier date than that I have just cited) carbuncle—not necessarily foiled at the ba[...] *en cabochon*, slightly hollowed behind, a[...] a plain gold surface, the light, as of a g[...] coal, quivers in the midst of a good stone[...] is a lovely disc of antique gold set with [...] buncles in the Gold Ornaments Room at the Museum. There is a round carbuncle bo[...] centre; then four long pointed arms, lik[...] elongated pears, radiate from this centr[...] nately with a somewhat similar series of arms, beaten up from the disc of gold, and [...] with nurled wires onlaid. There is n[...] work in the piece; the intrinsic value of [...] garnets is quite small, but the effect is de[...] simple, yet rich; solid, yet elegant. Can [...] praise be honestly given to modern garn[...] Can we feel a genuine satisfaction eithe[...] design, the execution, or the effect of a c[...] big carbuncle of eight lobes, with a six-ra[...] rivetted into the midst of it, the afore[...] being of hard, poor, glittering, much alloy[...] and containing a number of irregular frag[...] defective diamonds? The star soon ge[...] and, later on, the diamonds begin dropp[...] But I will not pursue the history of the p[...] farther, and I will refrain from calli[...] attention to other obnoxious modes of u[...] carbuncles say, in a ring with a sham g[...] on either side.

Amongst orange and yellow stones I unhesitatingly, assign the first place to th[...] zircon—a stone which is sometimes found which may be aptly described as that [...] parent gold. Next to this comes the c[...] stone, or essonite; and then we may place sherry-coloured Brazilian topaz—that ki[...] yields, when heated, the finest rose-pin[...] Yellow sapphires take an almost equal r[...] the best topazes, and then the chrysobery[...] and, at some distance, the yellow ber[...] colour combinations have been attempt[...] these yellow stones; puce-coloured spine[...] found to associate with the yellow sapp[...] happily, but there are some enamel[...] answer equally well. Generally, a desig[...] blueish-grey enamel, with minor details in buff and white, developes the richness coloured stones.

.. are two green stones about which some- ..ught to be said—the emerald and the tour- .. I do not sympathise with those persons ..gard the green of the emerald as vulgar. .. easy to construct a vulgar, coarse orna- ..nt of emeralds, even if they be of fine ; so much I will allow. But the emerald, .., and judiciously and quietly mounted, .. a rich and refreshing colour, just ..ly dichroic to show passages of bluish- ..th the green. Green tourmalines are much ..kedly dichroic, and it is much to be re- ..hat, with rare exceptions, the patrons of ..lers' art still remain ignorant, not only of ..liarly rich and varied qualities of the .. the tourmaline, but even of the existence ..em-stone. With moonstones, or with grey ..ite enamel, long prismatic tourmalines, ..y cut, afford a delightful colour-combina- ..uliarly fitted for larger pieces of personal ..ent, such as pendants and brooches. The ..d green garnets of the Urals, especially ..hich are of an olive or pistachio green, are .. and fiery stones, but their softness pre- ..heir use in rings. The same objection holds ..th regard to the lovely stone, the peridot, ..species occurs frequently of large size, and .. adapted for employment in jewels not .. much attrition. It is a dichroic stone; .. well with small puce, violet, or indigo ..lso with black and white enamel.

.. over, for lack of time, the varieties of ..wn as aquamarine, the green and blue .. blue topaz, and the green sapphire, I ..r for a few moments over the sapphire. ..oism of this stone, strong though it is, ..appear much in the cut specimens we ..e. But I do not doubt that the twin ..liversely-coloured light which this stone .. one azure blue, the other greenish ..ttribute to produce the peculiarly rich .. its velvety softness. There is a glittering ..n all the imitations of the sapphire— .. of their colour, if I may borrow a word ..ic, is harsh and unsatisfactory. So a ..itation, a kind of lime-spinel made .., exhibits apparently the right colour, ..at and uninteresting. To my eye, the .. between a true sapphire and a false one ..logue of the difference between a piece of .. wrought iron, and the same piece in .. As to the arrangement of the sapphire ..y, so much depends upon its depth of ..d its precise hue, that a general rule .. fallacious. Unless it be pale, when ..een tourmalines go well with it, the ..ay be most safely associated with pearls, .. moonstones, or white topazes the ..d size of the stones being carefully ..

.. had time to say something about the .. both the violet quartz and the harder ..ely rarer violet sapphire. But if I have ..pelled to omit such observations, and ..er things which I would gladly have .. I may, perhaps, entertain a reasonable .. what I have found time and opportunity ..ce may stimulate the production, and ..iation also, of new and choice colour- ..ns of precious stones, and may tend to a more lively and intelligent interest in those little-known and little-prized species, the jargoon, the tourmaline, and the spinel.

Before concluding, I may be permitted to direct your attention to two matters of considerable importance in connection with this subject, if our interest is to be sustained, enlarged, and educated. I refer to collections of specimens of precious stones, and to books on the subject. You must go to public museums if you are to see a jargoon or a tourmaline. With a very few exceptions, the largest and most noted London jewellers could not produce a single fine specimen of these curious stones, nor identify them if they were shown to them. I had five good stones mounted by a well-known goldsmith a few years ago, and he misnamed every one of them in the bill. Signor Giuliano, of 115, Piccadilly, is, indeed, the only artist-jeweller whom I know to have made a speciality of the judicious employment of these out-of-way stones.

I commend to your notice three collections of precious stones. In the Museum of Practical Geology, Jermyn-street, there is a small series amongst which the jargoons (especially a green one) are particularly fine. In the Mineral Department of the British Museum, now at South Kensington, a most complete series of every kind of precious stone, distributed, however, in many cases according to their mineralogical position, will be found. And the South Kensington Museum itself owns a fine series of mounted precious stones, 178 in number, the bequest of the late Rev. Chauncey Hare Townshend. Unfortunately, the official catalogue (1877) of the Townshend collection contains more than twenty incorrect or doubtful attributions. But you will learn much from this series, if you will bear in mind the corrections which I made in this list, in a paper published in the *Spectator*, on July 9th, 1870, which I repeated in the *Quarterly Journal of Science* for January, 1871, and which were adopted by Mr. Hodder M. Westropp, in his compilation, published in 1874, and entitled a "Manual of Precious Stones." I will just give you a single instance of how misleading are the names affixed to some of the Townshend gems. On page 17 of the catalogue (last edition), Nos. 1306 and 1307, and those only, are described as hyacinths, jacinths, or zircons. Both are garnets, and so the Townshend collection would appear to include no representative of this interesting species. But this is not so. For Nos. 1281 and 1282, called garnets, are really zircons; so, probably, is No. 1305, which figures as a chrysolite; and there is a fourth characteristic specimen, No. 1322, labelled tourmaline. But if you make these corrections, and 14 others (Nos. 1184, 1188, 1192, 1194, 1195, 1277, 1290, 1297, 1298, 1299, 1304, 1309, 1312, and 1318), you may study the remainder of these specimens with satisfaction and confidence. In a neigbouring case to the Townshend series there are some interesting specimens lent by the Right Hon. A. J. Beresford Hope. But here note that Nos. 60 and 61 are not jacinths, but garnets; that 42 is not a sapphire, but a bit of blue glass worth 4d. or 6d.; that 53 is not an emerald, but a bit of green glass, though next to it is a veritable emerald, or rather two, carved into a vinaigrette; that No. 110, called an aquamarine, is actually a sapphire, and that No. 113 is a tourmaline, not an aquamarine.

Of the many books written of late about precious stones, few have any claims to scientific exactness, or afford any satisfactory indication as to the artistic arrangement and use of precious stones. Many interesting facts and fancies about particular stones, and about their commercial aspects, are given in Mr. H. Emanuel's "Diamonds and Precious Stones" (1865); and more particularly in Mr. E. W. Streeter's "Precious Stones and Gems" (1877). But the little volume by M. Louis Dieulafait, entitled "Diamants et Pierres Précieuses" (1871), which has been translated into English, commends itself on many accounts as the neatest, cheapest, and most trustworthy manual of the subject which has yet appeared. I venture to refer also to my own papers previously named, to one in vol. i. of the *Magazine of Art*, and to a paper in the *Proceedings of the Geologists' Association*, vol. v., No. 7.

In conclusion, I must ask you to pardon the omissions, and they are many, in this paper, in which a large subject had to be handled in a short time. And I must ask you, further, to pardon the imperfect and inadequate manner in which I have attempted to express the results of my own thought and work, in those sections of the subject upon which I have found time to say something. If my paper serves in any way to stimulate and direct thought upon the artistic employment of precious stones, such a result will be as much as I could have hoped for, and more than I have warrant for expecting.

DISCUSSION.

The Chairman said they must all be very grateful to Professor Church for the very interesting paper he had given them, and he personally felt specially grateful to him for having exposed the shortcomings of the South Kensington Museum. Nothing was so healthy to any public institution as criticism, and he should not only take advantage of the criticisms he had heard, but should try to get from Professor Church, who seemed to be an authority on a large number of varied subjects, a popular handbook on this subject of precious stones. He had followed the paper with great interest, and he hoped there were some gentlemen present who would be prepared to discuss it.

Mr. Edmunds said he must confess that his business as a jeweller was carried on more by rule of thumb than on scientific principles; he was guided principally by what would sell, and therefore he could not pretend to instruct the meeting in any way. He cordially agreed with what the Chairman had said as to the value of the paper, and should be very much pleased to see a taste for precious stones cultivated. At present the jewellery business was guided mainly by intrinsic value, and there was not nearly so much taste and skill exercised in mounting as might be seen on the Continent. There was room for a great deal of improvement in this direction, and he hoped that this paper might have some good effect in directing more attention to this subject.

Mr. Liggins, after complimenting Professor Church on the paper, said his opinion was that when they had anything so magnificent as a diamond, ruby, or emerald, it was the duty of the manufacturer to assist, by a nice combination of colour and art in the setting to improve the appearance of those splendid gems. They were also indebted to Professor Church for information as to how to distinguish real from spurious gems. He did not know that he was ever more pleased than on one occasion last year, when he heard a paper at the Royal Societ on the manufacture of diamonds. His satis not at the fact that diamonds had been mad because he thought that would be a most application of science, but it was an extraor beautiful fact that the ingenuity of the ch produce what he believed was generally be the purest thing in nature, the pure ca diamond. At the same time, he believed very little prospect of the manufacture be out, except as a scientific experiment; that in fact, no chance of getting manufacture to supplant the work of Nature. In his jeweller's art had very much advanced last few years, especially since the Ex 1851. There had been a vast improvem setting of gems, and further advances migh for from that paper, and a study of the which reference had been made.

Mr. James Price said he was sure Profes would pardon him if he ventured mildly to cri or two points in the paper. He quite agreed that a great deal depended on the harmony wi colours were blended, in the production of wor in precious stones, and also in the form given but with regard to the condemnation which h passed on the practice of cutting stones there was this to be said, in the case of rubies, and other stones, if they were sufficiently pur that brilliancy for which they were so much and in which their principal value consisted, be an immense sacrifice to cut them in this w when they were not of first-rate quality, it wa advantage to cut them *en cabochon*, because it great extent the flaws and faults which the st tained. That was the principal reason for this form; and another reason was that they and were more in demand than facetted ston same class. Of course, the sale of stones, and th be made out of them, would always influence dealt in them, and there was a much greate for *cabochon* stones, especially in oriental clima probably the brightness of the light led th to look more to colour than brilliancy in stones. In the belts of swords and othe where they were used, a stone *en cabochi* have a better effect than a facetted one; and, ev country, a gentleman who wished to wear a r ring or a pin might not unnaturally prefer th appearance of a *cabochon* than one which woul more glaring, and as some might say, vulga Again, rubies made a beautiful combination as Professor Church had himself pointed in such a position they would require col brilliancy. Then Professor Church had against the use made of irregular monster p forming them into the representation of som object; but as they were formed by n these irregular shapes, in which they w gether inapplicable for necklaces or simi poses, the jeweller could only use them by fashioning them into the shape of a beetle, any other form which might suggest itself most suitable to the particular pearl. He t demned some of the common forms of jewelle country, particularly the half-hoop ruby ring it only showed the rubies. But such a ring w tended to be worn as a single article of jew would be accompanied by a diamond ring, or of the kind, so that one would set off the othe regard to the moonstone being very suitable for he would point out that it had no intrins scarcely more than a pebble or an agate, and, it would be useless and inconsistent for a jewelle it, because he would find no purchasers. these stones might look very well, there we means of disposing of them. They might be a beautiful work of art for a museum, but for

y would be useless. The same with regard Nobody asked for them, and no shop kept y did, they would not sell them, and there- were not mounted. The aristocracy, paid great attention to precious stones, to s, value, and distinguishing peculiarities, new very well that it was not difficult h these stones from rubies, because they much softer. With regard to the emerald dited by some people, and considered is just now—only temporarily, he believed hion. In all ages it had been highly d he believed it would always be con- reat value. It had a certain soft beauty always been admired, and it formed a mbination with the diamond. In these h depended on fashion, and, in the present pphire was greatly in demand, and there- mounted and sold; and he believed the day ald would come round again, and possibly and tourmaline might, at some future time, nd also. At present, though they might nd beautiful as works of art, they would be pt for museum purposes. What was wanted igher standard of talent should be employed, ction of those articles in which precious stones r artistic and ornamental purposes. Looking undreds of years, to the time of Benvenuto would find a much higher standard than ex- r, with all our advances in steam, machinery, re were much behind in such matters. Great been made in architecture, sculpture, and l he hoped the reading of this paper might to this subject also, and that they might untry those who possessed higher training devote themselves, as they did in former working up of these highly prized and ductions of nature. In the arts he had he practical men were highly cultivated, ry it was not so; the practical men were ics, and the designers were only one step wanted a higher order of intellect devoted n they might hope to rival the works of which at present they were far from doing.

its had listened with great pleasure to the the same time he thought Professor Church extent put the cart before the horse. as a very difficult subject, and was very but until it was so, and the public could e distinction between precious stones, it much use for the jeweller to supply them stic form; hence he simply made what He believed the Chairman would bear him he Science and Art Examinations, only a went up for mineralogy, as compared ls who studied other subjects, and until it tivated, he feared no advance would be rtistic production of jewellery. Prior to much behind France in all art matters, g only taught to a few who were supposed at for it; now it was taught to almost nd we were becoming an artistic ying not only designers for our own for others, especially the United States ies. When mineralogy was also gene- we might hope to make similar advances When at the Paris Exhibition, he was with the dexterity of the French in g jewellery, but he hoped through the he Society, and the City Guilds Institute, ment might be made. At the present time simply to money value, and would not t from which they did not expect to reap d it would only be by holding out to hope that artistic work would command a hat attention would be paid to the subject, t that improvement might be expected.

Mr. Nockold, as a practical lapidary, did not agree with Mr. Price that the cutting of stones *en cabochon* concealed their faults; on the contrary, he thought it would show them up. Again, with regard to moon-stones not being more valuable than pebbles, he could say from experience that they were much in demand at the present time, and that plenty of buyers could be found. Emeralds were still very valuable, and would fetch a long price.

Mr. Price said his contention was that the purest stones, as a rule, were not *en cabochon*, and he believed everyone of experience would confirm his opinion. Moonstones were not of any intrinsic value, as compared to precious stones. He was aware that there was a considerable demand for them at present for the American market, where they were used for pebble work.

Mr. William Botly said there were some of the finest precious stones ever collected together at the Paris Exhibition. He remembered in particular two enormous emeralds in a pair of bracelets, several hundred pounds in value, which he had the pleasure of examining. He noticed there was a difference in the colour of them, and though the proprietor would not at first admit that they were not a perfect match, he at last acknowledged that there was a difference, and that one was worth £50 more than the other. They were much indebted to Professor Church for bringing this subject forward, and insisting as he had on the importance of due care and skill in the arrangement of form and colour, for it was only by attention to these points that we could ever hope to rival the French and other workmen. Although Amsterdam had for many years stood almost alone in the cutting of diamonds, he understood that an immense deal was now being done in England. It had been said that the Koh-i-noor had been immensely reduced in size from injudicious cutting. He believed that both the late Prince Consort and the Duke of Wellington were consulted, and were present at the cutting; but if the facts were as represented, it showed the great importance of more perfect knowledge in the manipulation of precious stones.

Mr. C. J. Parton, while quite agreeing with Professor Church that there was little talent displayed in the mounting of precious stones, thought they could hardly wonder at the fact. In olden times jewellery was only worn by a few, and the man who mounted the stones came into direct contact with those who wore them, and he was well paid for his labour. It would be scarcely thought fit to apprentice a boy to an artist, who did not show some artistic talent, but jewellery was taken up as a trade, not as an art, and boys were apprenticed to it as to any mechanical trade without any talent at all. It was simply because there was not sufficient demand for artistic work, that they did not have it. He was quite sure that when the public taste was shown sufficiently to induce men of talent to devote themselves to it, knowing that they would receive that amount of remuneration due to art work, there would be a great improvement. But when a workman simply received an order for one article, and found a gross sold better, he would naturally devote himself to the gross.

Mr. Ford desired to corroborate the remarks which had been made by Mr. Price. He said that *cabochons*, as generally cut, hid the flaws in various stones, and as a lapidary of some forty years' experience, he (Mr. Ford), could confirm that statement, and he knew that in many cases, although not in all, it was adopted for that purpose. Moonstones were very common, and he had sold them in quantities at 4d. and 6d. each. It was not to be supposed that jewellery of fine quality would be associated with stones of that small value. As to the emerald, he would say that

it was the most beautiful stone of any next to the ruby, and he could not imagine how any one could call it vulgar. With regard to diamond cutting, the practice had now so improved and greatly increased in amount, that he believed in a few years' time the trade would be developed in London to the extent that there would be factories, as there were in Amsterdam, having two or three hundred men at work.

Professor Church, in reply, referred to the exact words he had used with reference to cutting stones *en cabochon*; he did not give it as his own opinion, or as the practice, but what had been advanced in several books, and especially in a lecture given by Mr. Ruskin some years ago at Oxford, in which he objected to any facetted stones at all. And there were several others of the same school who had objected over and over again to any facetted stones, good, bad, or indifferent. He did not agree that the commercial value of a material which was fairly hard, and useful for artistic purposes, was the sole criterion as to its employment. If red, blue, or other enamels were used, whose intrinsic value was a very small sum per pound, and most superb ornaments were produced with it in combination with gold and precious stones, why should you not use a lovely, brilliant, hard substance like the moonstone in decorative jewel work. There were one or two specimens in the case on the table which were worthy examples of the exercise of a good deal of labour. It was quite true that the spinel was not quite as hard as the ruby, but it was not very far short of it, as would be seen by the table. His own opinion of the emerald was that it was a lovely stone, and with regard to the jargoon and tourmaline, what they wanted was to lead public opinion to appreciate them. Of course they would not pay; very few people would buy them, but there were some collectors who did buy these stones, and he knew of many pieces of spinel work and jargoon work which had passed into very good hands. It was really not necessary to know much about mineralogy to be able to distinguish these things. An educated, keen sight, and a few simple instruments, used in a moment, would enable anyone to distinguish any of the stones which otherwise were rather difficult to determine without them. Lastly, he would say that the main object of his paper had been to introduce a discussion on the subject, and to show what might be done in various little worked directions.

The Chairman, in proposing a vote of thanks to Professor Church for his paper, said he hoped that a great deal of good would result from it, and that attention would be drawn to the various collections which had been mentioned. He had lived for 25 years at the South Kensington Museum, but he should take an early opportunity of inspecting the Townshend collection with a renewed interest, and he trusted that, out of the million of visitors who honoured the Museum during the year, many would be led to study that collection with more attention. The authorities, after what had been said, would take care to have all the specimens properly labelled, and possibly they might be able to add to the collection some of the specimens of which Professor Church had referred.

The vote of thanks was passed unanimously, and the meeting separated.

MISCELLANEOUS.

BREAD REFORM.

Dr. Graham, the author of the Cantor Lectures on "The Chemistry of Bread-making," delivered in 1879, has published in the *Miller* of the 7th February, a long letter on the subject of what is called "Bread Reform."

Dr. Graham combats many of the statements put forward at the Mansion-house last December, in favour of bread including the bran and husk. by summing up the doctrines put fortl Reform League as follows:—"1st. That w not contain sufficient albuminoids for die and that wheat-meal bread does contain s least, is incomparably better adapted for hu white bread. 2nd. They assert—or, at that the albuminoids of bran are of th value to man as the higher albuminoids o 3rd. They assert that the greater part of t is removed with the removal of the bran support their views as to the relative m meal and fine flour by economic considerat clude that the cheaper is by far the better repudiate the universal conclusions arrived ence to the relative merits of white and br being not due to the dictates of natu selection of that which is best for man, bu and an ignorant and debased taste. 6th ignore the impossibility of obtaining a v well-aërated bread by the fermentation recognising this, they imply the nec adoption of the Dauglish or other artil process."

Dr. Graham then proceeds to examine the arguments put forward by various s Conference. He commences with Mi Secretary of the League, who mainta nourishing bread is sufficient to supp population. To this Dr. Graham obje alone is an insufficient diet for a se animal. The next point taken up is the i bility of white flour, which is also said by contain less nourishment. To this Dr. G that the amount of bread eaten by F practical argument on the other side, inconceivable to believe that the white Vienna, Dresden, or Moscow, all rich i but deficient in bran, could be injuric eating them, and difficult to digest. H reason Frenchmen can easily digest larg bread, is simply because the bran has b Some enthusiastic remarks of Miss Y probability of pauperism, disease, and abolished by the use of whole-meal bread by Dr. Graham.

The next speaker was Professor Hensl that "the grain consisted of two part white tissue, which contained a prepond of but little nutritive value, and the outer gluten phosphates, &c.

To this Dr. Graham replies:—"It w miller or baker to learn that the fine v France, Hungary, and other countries nutritive value, because deficient in glu being that these flours are richer than a the amount of gluten they contain. Pe fessor meant only to assert that, in the ratio of albuminoids (not gluten, but ch was high as compared with starch; be th as reported in your paper, the statement plies that the greater portion of the i grain, being deficient in gluten and rich but little nutritive value. It is almost n that the statement is erroneous."

Professor Church is the next antag statement that the finest flour contains per-centage of nitrogenous substances is Dr. Graham. By Professor Church's Graham is led to comment on the aërated following terms:—"Here and there a stimulated, it may be, by the absurd tal filthy concomitants of the fermentation since removed by the introduction appliances—will eat and try to like aërat as thirty years' experience has shown, large will have none of it. Indeed, most

it a fair trial, have at last gone back to the ity" flavoured product of fermentation. The rocess of bread-making in Europe, as com- the fermentation process, is utterly insignifi- results. In short, on this matter, as on the f bran and other articles of diet, hasty aking mere chemical data as a guide, have to dictate to the world as to what it should hat it should drink. The world eats and t it likes, not what crude and groundless ites, and in so doing it is, in the long run, re and there an instinctive craving may be aps, but, as a rule, where natural preference d science conflict, the latter has gone wrong ide and ill-founded assumptions."

Church gave the ratio of albuminoids to to 5 in whole meal bread, but only 1 to 7½ white bread. This assertion is disputed by raham, who says:—"Even with English atio of albuminoids to starch is much higher and as two-thirds of all the wheat we con- ported from countries of more favourable ditions, and, therefore, with a higher of the albuminoids, the statement in regard is utterly erroneous."

am then goes on:—"The relative dietetic albuminoids of the bran and the gluten of ay now be discussed by me, in the exami- second proposition, which, briefly put, is cates of bran for human food, basing their ere chemical analysis, assert that the of bran, and also, as necessarily arising nd adhesion to mere chemical data, those ans, peas, linseed cake, and decorticated f finely ground, are of high dietetic value nivorous animal, such as man. How comes eague, while denouncing in no measured removal of bran from our bread material, ally and consistently, from their analytical rged us to go back to the use of peas and once so common, and even yet not al- nct. Again, considering the high per- buminoids in barley, oats, in beans, peas, y have they not had the courage of their nd urged that all these should be ground used as human food, and not given, as at r cattle, to elaborate into higher products ction of our carnivorous instincts? Liebig ly was a great chemist, but he was also herefore liable to err; and considering the nowledge at the time, and the speculative e Giessen philosopher, it is not strange ed at many erroneous conclusions on the ietetics. Bearing in mind the cheapness , peas, and feeding barley compared with nsufficient is the logic of the following:—

rtlett informed the meeting that Liebig that we made a very bad use of our corn, e flour ourselves and giving the coarser cattle, We also made bad use of our e paid at the rate of from 10d. to 14d. for hould only cost us 2d., and we fed our costing us 2d., whereas we only ought to hing per pound for it. If we eat the rts of our grain in the shape of pork in- r, Liebig thought, with a good deal of e were very bad economists, and not very ear, hear, and laughter.) It also followed bad food to our cattle, whilst we did not food for ourselves.'

nomic argument is to be allowed ignor- obscure questions of physiology, why did her urge on to us to eat the materials ove, all cheaper and far richer in albumi- eat, instead of giving them to our cattle? he views held at the so-called conference, based as they are on mere chemical data, and utterly oblivious of the vast difference between the digestive machinery and power of an herbivorous animal, with its complex digestive apparatus, and that of the simple one-stomached semi-carnivorous man, have been over and over again repudiated by the instinctive cravings of mankind. . . . The speakers at the Bread Reform Conference made use of chemical analysis to show that the world is utterly wrong in preferring white bread to brown bread, or whole-meal bread. Instinctive selection and preference is ignorant and wasteful, and chemical analysis is said to prove it, and therefore we must eat bran, or be guilty of sinful waste and crass ignorance of what they are pleased to call science. But why listen to likes and dislikes at all, and not urge upon all the necessity of eating grass, hay, oats, straw, and any other vegetable substance that chemical analysis indicates to be valuable, and that good economy shows to be cheap. This may seem absurd, but it is to what the chemical theories of the bread reformers must drive them, if their common sense be not better than their science. Now, the instinctive common sense of the world has relegated bran, along with grass, beans, and peas to our cattle, and in spite of an energetic and well-meant, though unscientific movement, the world will continue in this course, because based on real physiological necessities of animal digestion and elaboration, and not on hasty scientific, so-called, assumptions. Though a chemist myself, I must protest against obscure physiological phenomena, requiring all the highest powers of the ablest physiologist to be able to do more than guess at darkly, being authoritatively settled by the mere chemical analyst . . . . The ablest physiologists of Europe are unable to explain the obscure phenomena of digestion, elaboration, and repair of the tissues, but none of them would hesitate to reject with contempt statements as to the dietetic value of food substances based on mere chemical analysis. In short, chemical analysis is utterly worthless in settling this question; we require other and more legitimate scientific aid; but even physiology is as yet unable to authoritatively dictate to us in this matter, and when it is in such a position there can be but little doubt that its conclusions will, in the main, coincide with those adopted by the instinctive preferences of man; and these are against bran, beans, and peas, and such like cheap and nitrogenous products."

Professor Graham then discusses the statement that the greater part of the phosphates is removed in the bran. On this point he quotes Messrs. Wanklyn and Cooper, in opposition to Professors Church and Henslow. Dr. Graham then remarks:—"The children of the poor, insufficiently supplied with milk, may be deprived of a sufficiency of bone-forming materials when dieted too largely on bread. This, however, can easily and cheaply be overcome by the addition of precipitated bone phosphate along with salt in the fermentation process, or still more simply by the use of the process already patented for the treatment of yeast for bread-making. This treatment adds bone-forming material to stimulate the yeast organism, and also to increase the quantity of bone-forming matter in our bread. As this process has for its object to replace dear German yeast by cheap and powerful English yeast, this aspect of the question can be readily and economically met."

The fourth proposition is that whole-meal is cheaper than fine flour, and, therefore, economically to be preferred. On this head Dr. Graham remarks that the poor in large towns do not get the finest white bread, but rather bread in which some finely-ground bran exists, and, therefore, he argues that ill-fed, ricketty children must be affected by other causes than the use of white bread."

Dr. Graham then passes on to the sixth proposition given in his list. On this he says:—"I have, in my lectures at the Society of Arts, explained why the ground bran and ground embryo act so injuriously in the fermentation process of bread-making, and have

there shown that these albuminoids, like those in barley meal, have an energetic diastastic action on the starch, producing too much maltose and dextrin, which have an injurious effect on the colour of the baked bread. Again, these albuminoids, together with those found in barley, beans, and peas, have not the resisting elastic action of the gluten of wheat, and, therefore, are unable to produce the light, well-aërated, and easily-digested wheaten bread, such as we find in a good white loaf made by the fermentation process. This matter need not again be discussed in our columns, because your readers have already had the opportunity of studying these lectures in your issues of February, 1880, and subsequent months. It will suffice that I again repeat what is, after all, known to every baker, that finely-ground bran injures the bread by its injurious action in the fermentation process; and, further, that ill-elaborated wheats of our own country, of bad harvest conditions, though richer in albuminoids than that of excellent harvests, are comparatively poor in gluten, the invaluable essential for bread-making and for food. Here I would again state that of all cereals wheat alone can satisfy the conditions of the fermentation process of bread-making, and even with wheat, the inferior—and, from a dietetic point of view, comparatively useless—bran must be removed."

In conclusion, he sums up the statements made by the advocates for the consumption of bran, by saying that, "they fail to support their assertions on the following points:—1st. That white bread is deficient in flesh-formers, but that it is not so if mixed with some finely-ground bran. 2nd. In their contention, explicit or implied, by their strange adherence to chemical analysis, that all albuminoids, no matter the origin, are of equal value to the gluten of wheat and the albuminoids of flesh for semi-carnivorous man. 3rd. In their contention that three-fourths of the bone material of the ash of wheat is removed by the removal of the bran. Further, in using economical and analytical data to support them in their charge of ignorance on the part of the miller, baker, and consumer of bread, they have omitted to urge the far greater superiority, in both of these respects, of beans, peas, barley, linseed-cake, &c., which, from their analytical standpoint, they were bound logically to do. And then remarks that, "the farmer, miller, and baker must strive to improve the dietetic value of our bread in the following respects:—(a.) By the early kiln-drying of ill-matured and ill-harvested wheats of our own country. (b.) By the judicious admixture of 'hard'—that is, highly elaborated and matured—foreign wheats. (c.) By the improvement of our yeast. (d.) And lastly, by taking care that the flour of our 'soft,' and too often ill-matured home wheats, be not used in the preparation of the 'ferment' and 'sponge,' but only in the 'dough' stage. Such, it seems to me, are the right methods to adopt in the improvement of the bread of the poor, and not by the admixture of bran, however finely ground. The bran of wheat—like the skin of the potato, turnip, and other vegetable products, is best given to our cattle for elaboration into higher albuminoids for our use, notwithstanding the analytical arguments of the Bread Reform League."

MARBLE QUARRIES OF ALGERIA.

Thirty-four kilomètres north-east of Oran, on the high road to Arzeu and Mostaganem, is the small village of Mefessour; a branch road to the north-west leads to the still smaller village of Kleber. Above this rises the imposing mountain called Djebel Orousse, generally called "Montagne Grise" from its arid, grey appearance. The chain of hills, the highest point of which is about 2,000 feet above the sea, stretches in a north-easterly direction from Cape Aiguille to Cape Carbon, and includes Cape Ferrat. The central part of the range forms an elevated plateau, a level, with a superficies of 1,500 or 2,000 hardly any soil or vegetation, nothing, i as Consul Playfair states in his last repo an uninterrupted mass of marble and brec and finest, probably, that the world cont Playfair gives it as his opinion that, Mosque of Cordova, which, as regards n is an epitome of all the finest Roman and is marble of greater beauty or variety to as far as quantity is concerned, there is all France and Italy together, not except tains of Carrara. The discovery is due Monte, who was also fortunate enough well-known quarries of alabaster, cal onyx," at Ain Tekbulet, near Tlemçen. them from the Arabs for a mere trifle, a the country was still unsubdued, and wh approach them without danger to his lif obtained a concession of the "Montagne G period of years, and on very favourab area is about 1,500 or 2,000 acres only, obtained all the land round about in wh chance of marble being found, amoun 14,400 acres, so as to avoid the possib tition. The whole of this area is an uni of marble and breccia, which only req tached and carried away; roads have every direction, so that there is no pra in doing either. All over the surface plateau may be seen circular depressio sites of Roman quarries, and these, to indicate the position of the different soil, where any exists, is of a deep red ing small particles of iron ore; mine mineral exist in some places, and hav but there is not a sufficient quantity o make this remunerative. The ore has its purpose—a much more important o ing an infinite variety of rich tints to t breccia rocks. Consul Playfair rema fear to say all I wish on this subject, charged with exaggeration, but in sob the two days I spent in examining the g direction I passed from one marvel to a in amazement at the magnificence of the has so long lain, I will not say conceal to the most superficial gaze there." found not in isolated spots, or in limited in boundless profusion, and capable of liths of any size. Although many vari in practically inexhaustible quantities, common is the "Giallo Antico." varieties of tint are found, and Signor d that some of it is precisely similar to th columns of the Pantheon at Rome are m delicate and beautiful, as well as the mo marble of an exquisite rose tint, which is used either in large masses or in the fin tion. Consul Playfair states that he has s made of it, which could hardly be dist pink coral, and blocks from which the might be cut. With this rose-tinted found a rich creamy white, and anoth white; but it is in the breccias that the of form and colour is to be found, they perfectly homogeneous, the pebbles a which form the mass being of equal taking an equally good polish; there advantage, they leave no holes requirin with artificial cement when worked. Exhibition of 1878, there was a magni marble work in the centre of the Galerie by Monsieur Cantini, of Marseilles, obtained the gold medal. Almost every with this trophy, Consul Playfair say from the quarries of Kleber. From in

pear that the cost of extracting the marble porting it to the sea for shipment is not great. ection of the blocks costs 50 francs per cubic the transport to Oran (about 27 miles) costs and to Arzeu (12 miles) 25 francs. Royalties addition to about 30 francs per cubic mètre. ated that the marble could be laid on the an for 120 francs per cubic mètre, or landed for less than 200 francs. The only other f marble found in Algeria are the Algerian e mentioned, the breccia of Chennonah, of a or quality, and the white marble of Filfila, places, which can never compete with

IVATION OF THE CHESTNUT IN TUSCANY.

stnut tree has existed for centuries in Tuscany, one time nearly every hill and mountain side red with its foliage. The number of trees n Tuscany and Lucca at the present time is at several millions, and the nut and wood ributed more to the maintenance of the popu- ome of the districts than any other produc- me places, in fact, wheat, flour and corn meal y superseded by the chestnut flour, which is hing and much cheaper as an article of food rows to the height of 60 or 70 feet, and maturity at the age of 60 years; its l productiveness last for more than 100 any parts of Tuscany it is largely cultivated, s raised from the seed or nut; the larger panish chestnut is cultivated from grafting g trees. Mr. Schuyler Crosby, the United al at Florence, states that there are six nds of chestnuts cultivated—the Marone, e or Carrara, the Pastinees, the Rossolo, uolo, and the Brandigliano. The method of s as follows:—The chestnut is raised from lanted in earth which has been softened eatedly worked over. The plantations are iated near a stream, and the ground shaded r trees placed close together. The space the cultivation of the chestnut is divided , six or seven feet wide, and in each of re dug about three inches deep, and at a bout six inches from each other. In these s are placed, with the germs downwards. anure is not largely resorted to, although fect of rendering the plants more vigorous as it is dangerous, on account of trans- the young tree, finding itself on soil less has been accustomed to, easily languishes fter two years the plants are transplanted art of the plantation, where they remain fter which they are placed where they are remain permanently. The season usually ansplanting is after the falling of the gh it is frequently done even as late as March. There are two methods of graft- (which is done at the age of five or six the primitive method of inserting the bud a branch, with a slit in it, where it is re- x or other substances. The other, which and has proved the most successful in its ts in cutting large rings of bark from the e large or Spanish chestnut, and placing gs of the ordinary kind; this is a very ation, requiring great care, and is per- e following manner:—The bark of the nut is cut into circles on the twigs, where appear, care being taken to have one or each circle or cylinder, the bark is then m to loosen it from its position, and by hand, until a hollow cylinder of bark hich is then drawn up by the stem, that has been previously denuded of its bark in like manner. The cylinder of bark is then carried to the stem of the tree, which is grafted. This stem, having been previously denuded of its bark, and cut off down to the place where the ring is to be put on, is then covered with the ring, which unites with the growing bark, and sends out shoots of its own variety. In this manner a tree is covered with these rings, and the natural branches being cut down, all the force of the tree is expended in throwing out the shoots of the large chestnut from the grafted branches. Great care is always taken to cut off all shoots of the common chestnut that may appear near the grafted part, as they interfere with the full development of the part grafted. The operation of grafting by rings is practised in Tuscany from the 10th of April to the 1st of May, that being the time when the sap is running most freely, just before the leaves and buds come out. A method of pre- serving the grafting buds so that they may be good even after a year, is to place them in tin tubes filled with honey, and hermetically sealed immediately on their removal from the tree; another method of transporting the grafting buds, is by putting them into hermetically sealed tubes filled with water; this method can only be used for transporting the buds for distances accomplished under forty days. The chestnut produces flowers which after the usual process of the male pollen being deposited on the ovaries of the female flower, become chestnuts or the seeds of the tree; this change of the flower into the nut takes place about the end of July, and it is easy to foretell the crop of the year by the state of the nut germs, for although the flowers may have been abundant, fecundation may not have taken place largely, and it is only by watching the tree carefully after it has flowered, that a judgment can be formed as to whether the production will be good. The ovaries that are not fecundated by the flowers change into useless shells, but those which are fecun- dated become enclosed in buds containing one, two, or even three chestnuts. The nuts arrive at maturity in two months after flowering, that is to say, in October, and then fall to the ground; they are also beaten from the trees by peasants armed with long poles, but this is only occasionally done, as it seriously injures future fruit buds, and affects the yield of the tree for another year. The chestnut is pruned and trimmed every three years, which, while helping the tree to bear more abundantly, produces wood for fuel and other purposes, and the smaller twigs and branches, which are dried and used later for drying the nuts. The leaves are also gathered when green and young, and pressed flat in large bundles, and are then used for putting under pats of butter, and in making a kind of cake called "necci."

The Spanish chestnut has been cultivated with more than usual care and success in the province of Lucca, owing to the laws to protect it from destruction, passed by the Lucchesan Republic in the eleventh century. The chestnut is a very healthy tree; in fact, the only disease to which it is liable is internal decay of the trunk. Cases have been known where the whole life of the tree has been carried on through the external bark, while the interior was completely destroyed; the only way to arrest this disease is by burning out the whole of the interior of the tree by a slow fire. After the nuts are gathered, which is done by picking up those which have fallen, and not by beating the tree, they are deposited in huts, in the upper part of which deep trays are constructed on which the nuts are placed to the depth of six inches; in these huts slow fires of green wood are kept up, until they become hard and dry. They are then carried to the mill, where they are ground into flour, in the same manner as corn or wheat. From this flour many preparations are made, such as "polenta," and various kinds of cakes, fritters, and even a heavy kind of bread. The different ways of cooking the chestnut flour are known under the popular names of "necci," "pattoni," "castagnacci,"

"cialdi," "fritelli," &c., and the food so made is sweet and agreeable to the taste. The country people cook the chestnuts in water, and make use of this water as a medicine for chest diseases, colds, and coughs, and in most cases it has proved beneficial. The food made of the chestnut, which is most in favour, is the "polenta," made by simply boiling the chestnut flour in water for ten or fifteen minutes, with a little salt to flavour it, care being taken to keep up a constant movement of the paste, so that no part becomes burnt, which would thus spoil the mess; it is eaten with cream, butter, ham, &c., and is most healthy and nutritious. Another kind of food made from the chestnut is called "necci," which is flour formed into a cake, and is made by first mixing the flour with cold water, and making cakes piled on each other, and separated by chestnut leaves, pressed for the purpose, and moistened by water; the whole mass is then cooked over a hot fire, and the cakes taken off one by one, when the leaves are almost burnt. These cakes are generally eaten with cheese, Bologna sausage, and meat. Consul Crosby states that, in those regions where the inhabitants live almost entirely on the chestnut, they are of better appearance, and as strong as those who live on what is considered more wholesome and nutritious food.

GOLD MINING IN QUEENSLAND.

It appears from a report, issued by the Department of Mines, Queensland, which has just been presented to Parliament, that the approximate yield of gold in the year 1879, amounted to 288,556 ounces, as compared with 309,612 ounces in 1878. This decrease of 21,056 ounces represents a loss of £73,696, and would seem on a superficial examination to be a very severe falling off in the gold yield of the colony. But a decrease was anticipated, owing to the bed of the Palmer River (the principal deposit of alluvial gold) and its auriferous tributaries having been to a great extent repeatedly worked over, and consequently until new auriferous ground is discovered, a falling off must be expected. Although there is this considerable decrease in the quantity of alluvial gold produced, it has not been from the individual earnings of the alluvial miners being less than in the previous year, but from the decrease in the number of that class of miners. There has, in fact, been more gold produced in the Palmer district, relatively to the number of miners working during 1879, than there was during the previous year. This is accounted for by the improved system upon which the Chinese now work, that is, in large gangs sluicing, instead of as formerly, in small parties cradling, and by the discovery of several new patches of ground which, although of small extent, and soon worked out, yet yielded large returns.

The quantity of gold exported in 1879 amounted to 281,552 ounces, and it will be seen that there is a difference of 7,004 ounces between the amount exported, and that actually produced. This is due to the fact that a considerable quantity of gold is carried away in small parcels, by persons who do not make entries of it at the Customs. The number of miners at work in the colony in 1879 shows a decrease, as in 1878 there were 2,980 European quartz miners, 654 European alluvial miners, and 1,095 Chinese alluvial miners, in all 14,490; whereas in 1879, there were 2,750 European quartz miners, 441 European alluvial miners, and 5,621 Chinese alluvial miners, in all 8,812. Mr. Lukin, the under-secretary of mines, explains that this is but a rough statement, as the wardens of the separate gold-producing districts have not the means of obtaining a very accurate estimate; it is possible to arrive at a reasonably correct calculation of the number of settled quartz miners on the older fields, but not of the large floating population of alluvial miners, Chinese, and *prospectors*, scattered over thousands of square miles of country. The decrease in the number of Chines is very great; it appears, however, that 889 district alone, that of Cookstown, for China, w 54 have arrived from that country. Numbers for southern ports, many have taken to agricul other pursuits, a considerable number have themselves over the many old alluvial fie colony, and moving about in parties have escaped enumeration in the totals return wardens as engaged in mining. Death acc considerable number in the decrease; the among the Chinese having been abnorm during the early part of 1879. The fal the number of European alluvial miners is for by the exhaustion of the alluvial decrease in the number of quartz miners h principally on the far northern fields, where been disheartened by the difficulties against have had to contend, chiefly through the of capital necessary to work the ground. The commercial depression, so general thro colonies, has debarred the storekeepers, tra and speculators from backing the working mi previous years, when money was plentiful a easily obtained. Quartz mining is, however, factory condition, as in the principal reefing those of Charters Towers, Gympie, Hodgkinson, wood, Palmer, and Etheridge and Gilbert—the gold, in 1879, amounted to 175,668 ounce amount, though slightly less than that produ two previous years, considerably exceeds that when it amounted to 151,687 ounces. The however, is nothing more than the ordinary observable in the returns from all established during a series of years. Mr. Bligh, the wa district of Gympie, partly accounts for it by that, in some dividend-paying claims, raisin been suspended for a time during the erectio mining machinery, a change which, though immediate falling off in the production, inev to a better yield in the future. There is no in the richness of stone at the deeper levels worked, and new and promising ground has b Several new reefs, distant about ten miles fro of Gympie, but within the Gympie Gold F been tried. A trial crushing from the fir covered (the Veteran) gave a yield of nearly to the ton. Equally satisfactory reports com other districts. A comparison of the amou won with the number of miners working, the position of the individual miner conti prove. The actual number of men work Europeans, 3,191; Chinese, 5,621; making 8,812. As the total yield of gold for the 288,556 ounces, which, at an average of £ ounce, represented £1,009,946, it places the each individual miner at £114 12s. For the it was £74 15s. 8d. Excluding alluvial min is mainly carried on by Chinese, and tak reefing, which is exclusively in the hands of it appears that the yield in 1879 was 189,7 total value, £664,094; average earnings of e £250; against 179,038 ounces in 1878, value average earning of each miner, £201 9s. 9d.

CORRESPONDENCE.

SIGNALLING BY SOUND.

Attention having been called to the subjec signals in your *Journal*, it may not be unin your readers to know that we have recent and patented a sound signal whistle, that wi

y note in contrast, and also in combination. this apparatus has been submitted by us to R. Collinson, Deputy Master of the Trinity . Thomas Gray, Marine Secretary to the rade, and Mr. Douglass, Chief Engineer to House, and experiments were made by us ce of those gentlemen at Blackwall, on the 1881. We venture to say that this sound dopted, will prove a great boon to our preventing collision, and also for coast ses. We shall be glad to give further in- the sound signal on application to

Smith, Brothers, and Co.,
Brass Works, near Nottingham,

ing is the description of the instrument :— rdinary organ-pipe or cylindrical bell, and ically into two parts by means of a metallic , this forming two chambers in one bell. mbers regulating and adjustable stops are der to produce, from each chamber, two , one a high sharp-toned note, the other a e. This bell is then secured to a simple hich admits the steam to both chambers, tely or in combination. The steam being on the chamber on the right hand, gives ned note, and, on the left, a deep bass note, ng the steam to act upon both notes in t produces a loud, peculiar, harmonious desired, the regulating stop can be so t the high and low notes, when in will produce a discord sound. Distinct ristic sounds are also produced by or more sounding signal whistles, combination, each pitched in a different lue of this invention consists, not only high and low notes in contrast and but the bar or blade acts as a kind of d when the steam strikes upon it, thus und to penetrate to a much greater dis- d than the ordinary whistles can possibly ence of the sound being diffused equally d also in consequence of the wind acting e volume of steam, which weakens as well ts force. By this invention several notes ced separately, and in combination, by or more metallic blades in the cylinder, to regulate them. We will not further the attention of your readers by giving marks upon its application, as already stated by eminent authorities upon the ions at sea happening on account of le of sound signals being in use. Our lies this want. The high note may be rboard, the low note may be blown for two in combination for astern. These made continuous, because they are dis- , its adoption obviates the difficulty now of the coast fog signals being often mis- of steamers, because the sound produced n is so marked and distinct, that it would ssible to mistake one for the other. This lly applies to the sound signal-whistle, otes in combination, and pitched in dif-

OMY OF THE ELECTRIC LIGHT.

my disposal would not allow me to make to the economy of the electric light, ed to the recent advances made in March 30th, but some of the facts I are so interesting, that I venture to paper by this further note. At the ton Museum, very careful observations on the relative cost of the two systems, *i.e.*, gas and electricity. The Court lighted is that known as the "Lord President's" (or the Loan) Court. It is 138 feet long by 114 feet wide, and has an average height of about 42 feet. It is divided down the middle lengthwise by a central gallery. There are cloisters all around it on the ground floor, and the walls above are decorated in such a way that they do not assist in the reflection or diffusion of the light. The absence of a ceiling—the Court being sky-lighted—is to some extent compensated for by drawing the blinds under the sky-lights.

The experiments commenced about twelve months ago, with eight lamps only on one side of the Court. The system was that of Brush. The dynamo machine was driven by an eight horse-power Otto gas-engine, supplied by Messrs. Crossley. The comparison with the gas was so much in favour of electricity, and the success of the experiment so encouraging, that it was determined to light up the whole court.

The gas engine, which was not powerful enough, was replaced by a 14-horse power "semi-portable" steam engine, by Ransomes & Co., of Ipswich—an engine of sufficient power to drive double the required number of lights. The dynamo machine is a No. 7 Brush. There are sixteen lamps in all—eight on each side of the Court. The machine has given no trouble whatever, and it has, as yet, shown no signs of wear. The lamps were not all good, and it was found that they required careful adjustment, but when once they were got to go right they continued to do so, and have, up to the present, shown no signs of deterioration, although the time during which they have been in operation is nine months.

The first outlay has been as follows:—

Engine and fixing, including shafting and belting	£420
Dynamo machine	400
Lamps, apparatus, and conducting wire	384
	£1,204

The cost of working has been, from June 22nd to December 31st, during which period the lights were going on 87 nights for a total time of 359 hours:—

	£	s.	d.
Carbons	18	9	0
Oil, &c.	4	11	6
Coal	11	14	0
Wages	34	7	6
	£69	2	0

being at the rate of 3s. 10d. per hour of light.

Now, the consumption of gas in the Court would have been 4,800 cubic feet per hour, which, at 3s. 4d. per 1,000 cubic feet, would amount to 16s. per hour, thus showing a saving of working expenses of 12s. 2d. per hour, or, since the Museum is lit up for 700 hours every year, a total saving at the rate of £426 per annum.

In estimating the cost as applied to this Court, only half the cost of the engine should be taken, for a second dynamo machine has lately been added to light up some of the picture galleries, and the "Life" room of the Art School. The capital outlay should, therefore, be £994. In making a fair estimate of the annual cost, we should also allow something for per-centage on capital, and something for wear and tear. Take—

	£	s.
5 per cent. on the capital	49	10
5 per cent. for wear and tear of electrical apparatus	39	0
5 per cent. for depreciation of engines, &c.	21	0
Total	£109	10

leaving a handsome balance to the good of £316 10s. as against gas. The results of the working, both practically and financially, have proved to be, at South Kensington, a decided success.

I am indebted to Colonel Festing, R.E., who has charge of the lighting, for these details.

The same comparison cannot be made at the British Museum, for no gas was used in the reading-room before the introduction of the electric light, but the cost of lighting has proved to be 5s. 6d. per hour—at least one-third of that which would be required for gas. The system in use at the Museum is Siemens's, the engine being by Wallis and Steevens, of Basingstoke.

"An excellent example of economic electric lighting, is that of Messrs. Henry Tate and Sons, sugar refinery, Silvertown. A small Tangye engine, placed under the supervision of the driver of a large engine of the works, drives an 'A' size 'Gramme' machine, which feeds a 'Crompton' 'E' lamp. This is hung at a height of about 12 feet from the ground in a single storey shed, about 80 feet long, and 50 feet wide, and having an open trussed roof. The light, placed about midway, lengthways, has a flat canvas frame, forming a sort of ceiling directly over it, to help to diffuse the illumination. The whole of the shed is well lit; and a large quantity of light also penetrates into an adjoining one of similar dimensions, and separated by a row of columns. The light is used regularly all through the night, and has been so all through the winter. Messrs. Tate speak highly of its efficiency. To ascertain the exact cost of the light, as well as of the gas illumination which it replaced, a gas-meter was placed to measure the consumption of the gas through the jets affected; and also the carbons consumed by the electric illumination were noted. A series of careful experiments, showed that during a winter's night of 14 hours' duration, the illumination by electricity cost 1s. 9d., while that by gas was 3s. 6d., or 1½d. per hour against 3d. per hour. To this must be added the greatly increased illumination, four to five times, given by the electric light, to the benefit of the work; while this last illuminant also allowed, during the process of manufacture of the sugar, the delicate gradations of tint to be detected; and so to avoid those mistakes, sometimes costly ones, liable to arise through the yellow tinge of gas illumination. This alone would add much to the above-named economy, arising from the use of electric illumination in sugar works."

I am indebted for these facts to Mr. J. N. Shoolbred, under whose supervision the arrangements were made.

Some excellent experience has been gained at the ship-building docks in Barrow-in-Furness, where the Brush system has been applied to illuminate several large sheds covering the punching and shearing machinery, bending blocks, furnaces, and other branches of this gigantic business. In one shed, which was formerly lighted by large blast-lamps, in which torch oil was burnt, costing about 5d. per gallon, and involving an expenditure of £8 9s. per week, the electric light has been adopted at an expenditure of £4 14s. per week.

The erecting shop, 450 feet by 150 feet, formerly dimly lit by gas at a cost of £22 per week, is now efficiently lit by electricity at half the cost.

I am indebted for these facts to Mr. Humphreys, the manager of the works.

The Post-office authorities have contracted with Mr. M. E. Crompton, to light up the Post-office at Glasgow for the same price as they have hitherto paid for gas, and there is no doubt that in many instances this arrangement will leave a handsome profit to the Electric Light Company. They are about to try the Brockie system in the telegraph galleries, and the Brush system in the newspaper sorting rooms of the General Post-office in St. Martin's-le-Grand.

W. H. Preece.

OBITUARY.

Earl of Caithness.—James Sinclair, 14tl Caithness, whose death at New York, on Mor March, has been announced by telegram, wa the 16th December, 1821, succeeded his fathe and was created Baron Barrogill in the Peer United Kingdom, in 1866. He was elected r the Society of Arts in 1851, and was Vice- from 1863 to 1867. He obtained his Fellowsl Royal Society in 1862. Lord Caithness, many introduced on his estate in Caithness, a loco working on ordinary macadimised roads; he als some railway points of a new description. H tive genius was likewise displayed in a new for washing railway carriages by mechanical m an improved compass of great steadiness; tape loom, by which a weaver might stop or shuttles without interfering with the action of tl He was skilled in photography, and received a a landscape at one of the exhibitions held in t days of the photographic art. At his seat, S park, near Welwyn, he had two rooms fitte photographic and engineering appliances, f mental purposes. His lordship had the in making an extended American tour, but wa on board the steamer, and died from exhaust Fifth Avenue Hotel, New York, shortly afte

NOTES ON BOOKS.

Notes of Observations of Injurious Insects 1880. London: W. Swan Sonnenschein, 1881.

This report, which contains the result of M Ormerod's researches on this subject, cont matter connected with the visitation and insect pests, and its general circulation amon and gardeners is likely, in some measure, to extirpation of many of the most destructive. the weather and atmospheric conditions gene year under review, Miss Ormerod shows that of 1880 was remarkably suitable for vegetal by its alternations of dry and sunny wea storms or periods of rainfall to press on the from most of the localities where the weathe thus favourable there are also returns of the sm of insect injury. The great insect attack was that of the larvæ of the *Tipula oleracea*, known as the daddy longlegs. The carrot flies were also very destructive. As an illu the amount of cold the grubs of insects c it may be mentioned that some grubs of long-legs were frozen by artificial mea Kew Observatory down to a temperatu below zero, or 42° of frost, and thou all the grubs died under the experime showed that, exceptionally, the grub co even this amount of cold, to all appearance As a further proof of this, one observer m stances where the grubs have been frozen were quite brittle, and upon being thawe lively as ever. An experiment as to the e is recorded, in which a number of cab planted in flower-pots, all the plants being i thriving state before the grubs were in them. "Salt was then applied upon thes being increased in quantity until pla

l; and, on examination, the grub was found sed depths in the soil, this depth below the seeming to be regulated by the amount of salt but all the grubs were found to be in no way e for the application." Soaking in strong brine ty-four hours has been tried, but it has not em; and shortness of food also for a long time lso to have but little effect upon them. One states that he placed some of them in a glass vith a little soil, but no plant food, and three after they appeared all right. The one at seems fatal to them is drought. The moth (*Abrax as grossulariata*), and the goose-aw fly (*Nematus Ribesii*), were very plenti- and destructive to gooseberry bushes. Re- the first, picking the caterpillars off by hand l mode of effecting a riddance. This, however, gardens, is a tedious operation, and powdered e, scattered over bushes after thoroughly wetting so as to make the powder stick, is recommended re and easily applied remedy." It is necessary, , to see that the berries are carefully washed eing used, as the powder is a dangerous poison. ng with Gishurst compound is also recommended. plans are recommended by different observers xtermination of the saw fly, one of which is pieces of woollen cloth be laid among the bushes, will deposit her eggs on them, and by removing s, they can easily be destroyed. Another plan inge the bushes with warm water in the spring, ng taken not to have the water too warm to he young foliage. The best plan, however, be to remove the soil to the depth of two inches e bushes in the early spring, and to give a good g of lime round each bush; by this means the ars are cleared away and destroyed.

GENERAL NOTES.

na in Jamaica.—From a memorandum of Mr. s, Director of Public Gardens and Plantations in (dated January 31, 1881), it appears that, in the of 18th August last, many thousands of cinchonas blown down and uprooted. In consequence, it ssary to resume barking operations in spite of the ableness of the season. The bark was cured with such at the whole consignment, consisting of 180 bales, hing in the aggregate 14,397 lbs., was ready for within a few weeks of the occurrence of the hurri- The total results of the cinchona sales during the last onths now show a gross return of 41,696 pounds ark as having been shipped, yielding a total value 10s. 8d.

ation.—It appears from Mr. Giffen's report, xcess of emigrants to, over immigrants from, the untries in 1880 was as follows:—United States, British North America, 16,214; Australasia, ll other parts, 5,995. Compared with the previous increase to the United States alone was 68,000, reduction to Australasia was more than 50 per the figures of the previous year. In 1876 and ween 60 and 70 per cent, of the whole excess of was to Australaisa; last year it was less than 10 of the whole. There left our shores for the United ,081 English, 14,471 Scotch, and 83,018 Irish; for orth America, 13,541 English, 3,221 Scotch, and h; for Australasia, 15,176 English, 3,059 Scotch, Irish; for all places, English, 14,047, Scotch 1,305, . The grand total is 227,542 compared with 1879. Including foreigners, 332,294 individuals hores, 281,560 as steerage passengers, and 50,734 passengers. Of the former 156,150 sailed from , 26,058 from London, 19,068 from other English ,846 from Glasgow; and 53,944 from Londonderry all of whom went to the American Continent, in rtion of 17 to the Republic to one to the Dominion.

Gold Production of the World.—The recent report of Mr. Burchard, Director of the Mint in the United States, contains a *résumé* of the production of gold and silver for 1879 and the two previous years. The total yields were:—

	Value. Gold.		Silver.
1879	105,365,697 dols.	....	81,037,220 dols.
1878	119,031,085 „	....	87,351,497 „
1877	113,947,173 „	....	81,040,665 „
Total....	338,343,955 „		249,429,382 „

Or a grand total for the three years of 587,773,337 dollars, or about £146,943,000. The yield of gold and silver in the United States during 1879 was nearly equal, being 38,899,858 dollars of the former, and 40,812,132 dollars of the latter. Australia comes next, with a production of 29,018,223 dollars, all in gold, and she is closely followed by Russia, which furnishes a tolerably uniform annual supply of about 27,000,000 dollars of gold, though but a small quantity of silver. The Mexican yield is almost entirely silver, value 27,000,000 dollars. There has been a considerable falling off in the coinage of the world during 1879 to that of the previous years, the coinage of 1879 being in value 207,287,384 dollars, while in 1878 it was 349,578,524 dollars.

Cardamom Cultivation.—The cultivation of cardamoms is, according to Mr. Markham, carried on to a great extent on the western slopes of the Coorg Mountains. In the month of February, the Coorgs start from their villages, and arriving on the mountain slopes, select one of the largest trees, giving a preference to those on a western or northern slope. Around this selected tree they raise a platform, and commence to fell it. In felling it, they take care that it shall fall towards the base of the slope, and thus, in its fall, carry all before it. Having cleared a space of some 300 ft. long by 40 ft. broad, and freed it from all brushwood, they commence planting. In three months the plants begin to appear; after about 20 months, the plants have reached a height of five feet, and in six months later, that is 26 months after the first sowing, the first clusters of flowers begin to appear. During this period the ground is kept constantly cleared of all weeds. Six months (October) after flowering, the first crop is ready for picking, but a full crop is not obtained till the following year. These plantations are kept up for six or seven years, when the soil having become exhausted, fresh ground is again cleared. The harvesting is attended with some amount of suffering, as the grass which springs up around the cardamom plants cuts like a knife, and large leeches are very abundant. The capsules, when picked, are packed in bags and carried to the villages, a distance, frequently, of ten to twelve miles. Some families have been known to collect cardamoms to the value of 600 to 1,000 rupees per annum.

Petroleum in Venezuela.—A remarkable deposit of petroleum is described by the American Consular Agent at Maracaibo as existing between the Rio Tara and Zulia. Near the former, there rises a sand-bank about 35 yards in extent and some 10 yards in height. On its surface is visible a collection of cylindrical holes, apparently artificially made, and of different diameters, through which streams of petroleum, mixed with boiling water, gush out with great violence, accompanied with a noise as though two or three steamers were blowing off steam. The column of vapour that ascends from it would doubtless be seen from a long distance, were it not shrouded by the thick forest, to which the petroleum beds that evidently lie underneath give a perpetual greenness and freshness of foliage. Dr. M'Gregor states that from one of these holes, notwithstanding the difficulties of the position, he filled, in 42 seconds, a vessel containing 15 bottles, or as fast as four gallons per minute, or 240 gallons per hour, or 5,760 gallons during the 24 hours. A curious phenomenon has been occasionally seen in Venezuela ever since the conquest, consisting of a frequent lightning, without any explosion, which is observable from the bar at the entrance of the Lake of Maracaibo, close to the island of Bajoseco, and which Colonel Codazzi, in his geography, attributes to the vapour ascending from the Cienega de Agua Caliente. This appearance, called by mariners, "El farol de Maracaibo," is more probably due to the inflammable gas that permeates the whole district to such an extent that it is known by the natives as El Infierno. There is no do doubt that the supply of petroleum is very abundant not only here but in the neighbouring Republic of Columbia, where, between Escuque and Bettijoque, the

labourers gather it up in handkerchiefs, which, when saturated, are squeezed out into barrels.—*Times.*

Hours of Labour in French Manufactories.—The following are the regulations as to work in factories definitely proposed to the French Chamber:—Art. 1. The duration of work in factories and workshops must not exceed ten hours a day, or six days a week. 2. Nightwork (between 9 p.m. and 5 a.m.) is forbidden in these establishments so far as women are concerned; but, in the event of stoppage resulting from an accidental interruption, or *force majeure*, the above restriction may be temporarily removed, for a given period, by the local committee or the inspector appointed by the law of 1871. 3. Government regulations will determine the exceptions to the provisions contained in Arts. 1 and 2 on account of the nature of the industries, &c. 4. Any manufacturer or manager acting in opposition to the present law and the Government regulations will be proceeded against, and punished with a fine of from 16 to 20 francs. The fine will be enforced as often as persons are employed in a manner contrary to law, provided that the total amounts do not exceed 500 fr. (£20). On a second conviction within twelve months of the former, the delinquents shall be liable to a fine of from 50 to 500 fr., provided that the total sums do not exceed 1,000 fr. (£40). 5. The local committees and inspectors of children's work in factories appointed by the law of 1874 are charged with the application of the present law, which (6) repeals that of 1848.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at eight o'clock:—

April 27.—"Five Years' Experience of the Working of the Trade Marks' Registration Acts." By Edmund Johnson.

May 4.—"Buying and Selling; its Nature and its Tools." By Professor Bonamy Price, M.A. Lord Alfred S. Churchill will preside.

May 11.—"The Manufacture of Glass for Decorative Purposes." By H. J. Powell (Whitefriars Glass Works).

May 18.—"The Electrical Railway, and the Transmission of Power by Electricity." By Alexander Siemens.

Foreign and Colonial Section.

Tuesday evenings, at eight o'clock:—

May 10.—"Trade Relations between Great Britain and her Dependencies." By William Westgarth.

Applied Chemistry and Physics Section.

Thursday evenings, at eight o'clock:—

April 28.—"Impurities in Water, and their Influence upon its Domestic Utility." By G. Stillingfleet Johnson, F.C.S.

May 12.—"Recent Progress in the Manufacture and Applications of Steel." By Prof. A. K. Huntington.

May 26.—"Telegraphic Photography." By Shelford Bidwell. Prof. W. G. Adams, F.R.S., will preside.

Indian Section.

Friday evenings, at eight o'clock:—

April 29.—"The Building Arts of India." By General Maclagan. Andrew Cassels, Member of the Indian Council, will preside.

May 13.—"Burmah." By General Sir Arthur Phayre, G.C.M.G., K.C.S.I., C.B.

Members are requested to notice that it may be necessary to make alterations in the dates of the above papers.

Cantor Lectures.

Monday evenings, at eight o'clock:-

The Fourth Course will be on "The making," by Alan S. Cole. Four Le

Syllabus of the Course.

Lecture II.—April 11.

Needlework upon a material. Needlewo rate threads. Venetian needle-point la point and tape lace. French needle-point centres. English and Flemish needle-poi

Lecture III.—May 2.

Fringes. Twisted thread-work in Er 15th century. Early designs for plaited threads. Italian, Flemish, French, and F lace. Laces of primitive design.

Lecture IV.—May 9.

Resumé as to styles of design in ha Traditional patterns. Sketch of the de inventions for knitting and weaving thre lace. Differences between machine an laces. Modern hand-made laces at Bu Honiton, &c.

This course will be illustrated by speci Diagrams and photographs enlarged will means of the lantern and oxyhydrogen li

The Fifth Course will be on "Colo and its Influence upon Various Ind R. Brudenell Carter, F.R.C.S. Th

May 16, 23, 30.

MEETINGS FOR THE ENSUING

Monday, April 11th...**SOCIETY OF ART** Adelphi, W.C., 8 p.m. (Cantor Lectur Cole, "The Art of Lace-making." (L
Royal United Service Institution, White 1. Mr. R. Griffiths, "On Recent Expe Propulsion." 2. Mr. G. Fawcus, "On I tating Handling and Traversing of He
Royal Geographical, University of Lond gardens, W., 8½ p.m. Colonel H. C. T fatory Remarks by Mr. R. N. Cust, the Siah-posh Kafirs of the Hindu Kus
Medical, 11, Chandos-street, W., 8½ p.m.
Victoria Institute, 7, Adelphi-terrace, W N. Whitley, "Supposed Palæolithic To of the Axe, Devonshire."

Tuesday, April 12th...Medical and Chirurgic street, Oxford-street, W., 8½ p.m.
Civil Engineers, 25, Great George-st., We 1. Discussion on Mr. B. Baker's pape Lateral Pressure of Earthwork." 2. Mr "The Relative Value of Upland and producing Scour."
Statistical, Somerset-house-terrace, Stran
Photographic, 5a, Pall-mall East, S.W., 8
Anthropological Institute, 4, St. Marti 8 p.m.
Royal Colonial, Grosvenor Gallery Lib Bond-street, W., 8 p.m. Mr. Thomas A land, her History, Resources, and Futu
Royal Horticultural, South Kensington,

Wednesday, April 13th...Sanitary Institute of Conduit-street, W., 8 p.m. Address of Council, Dr. Richardson, entitled Suggestions on the best mode of dealing and other Infectious Diseases in the other large Towns."
Graphic, University College, W.C., 8 p.m.
Microscopical, King's College, W.C., 8 p Shrubsole and Mr. F. Kitton, "The London Clay."
Royal Literary Fund, 10, John-street, 3 p.m.

Thursday, April 14th...Telegraph Engineers 25, Great George-street, S.W., 8 p. George Lane Fox, "The Application Lighting and Heating for Domestic and 2. Professors Ayrton and Perry, "A P Galvanometer for Strong Currents." Perry and Ayrton, "A New Tran mometer."
Mathematical, 22, Albemarle-street, W.,

L OF THE SOCIETY OF ARTS.

No. 1,482. Vol. XXIX.

FRIDAY, APRIL 15, 1881.

...tions for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

CANTOR LECTURES.

...ond lecture of the fourth course was ...n Monday, 12th inst., by Alan S. Cole, ... Art of Lace-making." The lecturer ...needlework upon a material, needlework ...ate threads, and the various kinds of ...t lace. The third and fourth lectures ...n on May 2 and May 11 respectively.

...EIGN AND COLONIAL SECTION.

April 5, 1881; John Rae, M.D., F.R.S., ... The paper read was on "Canada: ...lony and the new Dominion." The ... be printed in the next number of the

...DINGS OF THE SOCIETY.

CHEMISTRY AND PHYSICS SECTION.

..., March 24, 1881; Latimer Clark, ... the chair.

... read was on—

...UTURE DEVELOPMENT OF ...LECTRICAL APPLIANCES.

...sor John Perry, B.E., Assoc. M.I.C.E

... been my intention to introduce this ... your notice by speaking of the great ...sical science has already done for ... I assure you, that I had arranged a ...re harangue on this subject, touching ...ns, and Newton, and Boyle, and Watt, ...y, and Joule, and Thomson, showing ... these men in their laboratories who ... way for Stephenson, Wheatstone and ...me, Hughes, Edison, and Graham Bell. I meant to tell you how, in days gone by, a few Birmingham business men subscribed to give their townsman, Priestley, sufficient money to live upon while working at original research; and I felt able to prove so clearly to you, that it was for the good of the nation to provide scientific men with large laboratories, and to ensure them freedom from ordinary cares, that in the mere preface to my proper subject, I prepared an hour's lecture. Luckily, I remembered that you had all had opportunities of hearing about the benefits you owe to science; and I bethought me that you might even be tired of listening to truisms regarding endowment of research; truisms to members of the Society of Arts, but not so well believed in by the general public, and especially by that section of the general public which sees reason to lean on Mr. Ruskin, in whose nostrils the mere names of Watt and Stephenson are as the savoury odours of the Thames at low water, and attends to the views of Sir John Ellesmere, who hated telegrams more than he disliked our common enemy. Men of this stamp may well think of the future with horror, for there is every sign that applied science is increasing the acceleration of the rate of its development. To such men I would say—Put a stop to laboratory work; set your faces against the endowment of research; root up the acorn if you would not in the future be plagued with the oak. The applied science of the future lies invisible and small in the operations of the men who work at pure chemistry and physics. These men do not know what will be the outcome of their labours. They often think that they sympathise with Mr. Ruskin; but you might as well ask a dram-drinker to give up that which his soul loveth, as ask a man who has done real experimental work to give it up. I have often watched Sir William Thomson, to whom every object in nature is continually suggesting new ideas, new experiments; to whom every particle of brass scraped off by a file is a being full of complication, an object of interest, and a thing of beauty, and to whom the study of the bending of a bit of brass wire is a joy for ever. Sir William Thomson believes in applied science, but such belief has really nothing to do with the delight which he and every other experimenter has in his work.

Now, electrical science has reached a position from which, on every side, hundreds of enticing paths lead forward into unexplored regions of nature. At every step in advance, the laboratory worker sees to right and left of him new and promising lines of research; and he feels that, for the work to be done, the present army of explorers is all too small and weak. But interesting as it might be to prophesy on investigations newly begun, it is rather my purpose, to-night, to take you upon the well-trodden ground prepared for us by Faraday, and Joule, and Thomson, to show you how, in one or two great lines of the applied science of electricity, certain fixed laws tell us about the future. I shall then speak of a few of the more recent discoveries.

Now, in the first place, you must remember that electricity is, to us, something that can be measured; although, unfortunately, to the ordinary telegraph operator, this is not the case. If you can imagine a mechanical engineer regarding

a distance of a few inches as being equal to the distance of a few miles, or even of a few thousand miles; if you can imagine a grocer to confound an ounce of sugar with a ship's-load of the same material, you get a too truthful idea of the vagueness, the general want of definiteness, in the notions of nearly all students of this subject until a few years ago, and, I am sorry to say, that much of this vagueness is still to be found even in modern scientific papers. Perhaps, when electricity is supplied to every house in the City of London at a certain price per horse-power, and is used by private individuals for many different purposes, this vagueness will finally disappear.

To get exact ideas in any department of physics, we have one firm foundation to build upon, viz., that a certain amount of energy or power of doing work remains always the same, in whatever form it may appear. I have here various sources of electricity—a voltaic cell, a thermopile, a glass-plate machine, a magneto-electric machine, which may be turned by hand, and two dynamo-electric machines outside, which I can drive by means of a steam-engine. As you know, there are many others. To all these, some form of energy is given, and they convert this energy, badly or well, into electric energy. The cell burns zinc; in the thermopile gas is burnt; to the three last machines mechanical energy is given; they all give out electrical energy. Now, how do we know that there is a production of electrical energy? Let us take any one of them (this voltaic cell, for instance). Some form of energy is given out, for you see that I can convert it into heat. (Experiment shown.) Here I take advantage of a property somewhat analogous to mechanical friction.

This thermopile is also generating electricity. To test this I connect its poles to the wire of a galvanometer, and the instantaneous deflection of the needle of the galvanometer tells me about the current. (Experiment shown.) Here is another proof that some kind of energy is traversing the wire connecting these two screws. The two wires are attached to an arrangement at the other end of the room; when I complete the circuits, whether I do it here or there, the bell rings. (Experiment shown.) You see that in this case the heat energy given out by this burning gas is converted partly into electrical energy, in which state it can be transmitted to a considerable distance, and there converted into mechanical energy, or into sound, or into any other form of energy. In these and other ways we can detect the existence of the electrical energy coming from all these generators, and measure its amount. Now, Joule's experiments tell us that any generator gives out exactly as much energy as is given to it, but much appears in the form of heat. All these generators get heated, and may be said, therefore, to waste energy. One great object of the inventors of such machines, is to give out as much as possible of the energy supplied to them in the shape of electrical energy. You must clearly distinguish between electricity and electrical energy. A miller does not merely speak of the quantity of water in his mill-dam; he has also to consider the height through which it can fall. A weight of one thousand pounds falling through a distance of one inch represents the same energy, that is, gives out the same amount of work in falling as one pound through one inches. A mere statement, then, of th of electricity given out by a machine is in it is also necessary to state what is the difference of potential through which it The quantity of electricity in a thund comparatively small, but the difference c through which this quantity passes whe occurs is exceedingly great. So it is w factors of the electrical energy develop glass machine. The quantity of electric able from this machine is comparatively it is like a small quantity of water at ingly great height, whereas, in all t machines we have, in the analogy of th very great quantity of water and a difference of level. I put this water a fore you because you have all more or notions about water, and because, with limits, the analogy is a very true one traced it more fully in the wall-sheet I.

Wall-sheet I.

We Want to Use Water.	*We Want to U*
1. Steam pump burns coal and lifts water to a higher level.	1. Generato or uses mecha and lifts elec higher level or
2. Energy available is, amount of water lifted × difference of level.	2. Energy amount of el difference of p
3. If we let all the water flow away through channel to lower level without doing work, its energy is all converted into heat because of frictional resistance of pipe or channel.	3. If we electricity flo wire from one generator to without doin the electrical e verted into he resistance of w
4. If we let water work a hoist as well as flow through channels, less water flows than before, less power is wasted in friction.	4. If we l tricity work a well as flow th less flows than power is was the resistance
5. However long and narrow may be the channels, water may be brought from any distance, however great, to give out almost all its original energy to a hoist. This requires a great head and small quantity of water.	5. However thin the wir electricity ma from any dis ever great, almost all energy to a ma requires a gre of potentials current.

You will readily understand then th purposes it is necessary to have or energy in the shape of a small quantit city falling through a great difference and for other purposes a great quantit city falling through a small difference When electricity falls through a d potential, this difference is called motive force. It would take me too you why we use two terms to express to be the same thing; but briefly "difference of potential" is analogous ference of pressure" or "head" of soever produced; whereas electro-mo analogous with the difference of pre and behind a slowly moving piston c

ɔy an unfortunate miller to produce his ly.

object of my paper is to show you icians have very definite ideas on the ey are working at; that the measure- which their work depends, have exact and that there is hardly any problem in nan's powers which you can set before ve which they may not hope to do with costly apparatus. Everybody knows il engineer is still very far from having limiting lengths or sizes to which large l other structures may be built, at a less cost. Everybody is competent to ghly correct judgment in such matters, rybody has more or less correct notions weight, and strength of materials. And way that you may be able to guess of lectrician may do in the future, it is that you get fairly correct ideas of agnitudes; and the curious fact is how simple it is to arrive at these , so few people possess them. On the II and III, I have given such help as visibly in this matter; but time will f my entering into such explanatory should desire.

heet II.—Electrical Magnitudes.

(some rather approximate.)

of copper wire, one- an inch diameter	0·002 ohm
rdinary iron telegraph	10 to 20 ohms
selenium cells	40 to 1,000,000
graph insulator	4,000,000,000,000

orce of

	Volts.
opper-iron junctions at a of temperature of 1° .... =	0·000,01
zinc and copper .... =	0·75
l's cell................ =	1·1
r Clark's standard cell.. =	1·45
De la Rue's batteries.. =	11,000

flashes probably many millions of volts.

ıred by us in some experiments:—

rometer...... =	almost infinitely small currents.
	Weber.
ate galvanometer.... =	0·000,000,000,040
ceived from Atlantic when 25 words per re being sent ...... =	0,000,001
ordinary land tele- ies .... =	0·003
m dynamo machine.. =	5 to 100 Webers

uit, *current* in webers = *electromotive force* istance in ohms.

III.—Rate of Production of Heat, ed in the shape of Horse-power.

of a circuit = *current* in webers × *force* in volts ÷ 746.

of circuit = *current* in webers × *difference* at the two ends of the part of the section ÷ 746.

e of current in webers × resistance of ohms ÷ 746.

e a number of generators of electricity in a circuit, whose electromotive forces in volts are—E_1, E_2, &c., and if there are also opposing electro-motive forces, F_1, F_2, &c., volts, and if C is the current in webers, R the whole resistance of the circuit in ohms, P the total horse-power taken in at the generators, Q the total horse-power converted into some other form of energy and given out at the places where there are opposing electromotive forces, H the total horse-power wasted in heat, because of resistance, then—

$$C = \frac{(E_1 + E_2 + \&c.) - (F_1 + F_2 + \&c.)}{R}$$

$$P = \frac{C}{746}(E_1 + E_2 + \&c.);\ Q = \frac{C}{746}(F_1 + F_2 + \&c.);$$

$$H = \frac{{}^2CR}{746}$$

The lifting-power of an electro-magnet of given volume is proportional to the heat generated against resistance in the wire of the magnet.

The future of many electrical appliances depends on how general is the public comprehension of the lessons taught by these wall-sheets. If a few capitalists in London would only spend a day or two in learning thoroughly what they mean, I am quite sure that electrical appliances of a very distant future would date from a few months hence.

It is not necessary for me to tell you now that electrical energy may be produced. Nor need I waste time in speaking of how it may be transmitted to a distance by means of insulated metal wires. A more important fact is that, when electricity is flowing in a wire, I can transform part of its energy into other shapes. For instance, here is an iron wire of 2 ohms resistance. Suppose this to be in a cold room, and I turn on the electricity tap. (An electric machine, driven outside by a gas-engine, is here my source of energy.) This wire is now getting a supply of electrical energy, and is converting it into heat. Mr. Andrews tells me that there is now a current of 20 webers flowing through the wire, and hence the wire is giving out more than one horse-power in the shape of heat. Some of you may have thought that very little heat can be given out by such a wire; but these are the exact figures, and you can all see that they represent a pretty large supply. When the current has been flowing for a short time, the neighbourhood of this wire will be found unpleasantly warm, and I can assure you that the use of this instrument for certain measuring purposes is very disagreeable in the summer time. It is hardly necessary to say that a wire, through which a current is flowing, may be made to give out its heat for a great variety of purposes. The temperature may be pretty much what we please. Thus, I turn the tap, and this wire gives off very intense heat. (Experiment shown.)

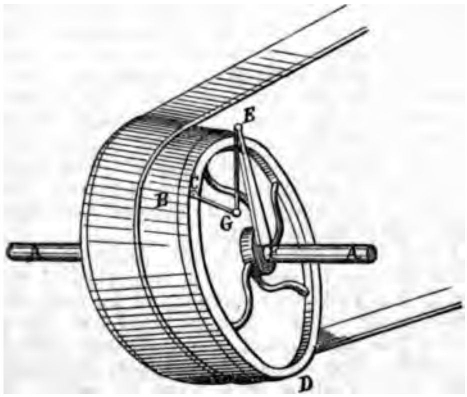
I had asked my friend, Mr. Andrews, to boil water for you by means of a hot spiral of wire; but he has given us something of his own which is very much better. You see that I turn this tap, and so pass this current among all these little bits of carbon; first we have bright spots of light here and there stealing from point to point; then these lights fix themselves in definite places, and round them the carbon gets red hot, until we get in two minutes the most perfect form of fire for

heating a room or boiling a kettle that I have ever seen. I have in vain tried to get Mr. Andrews to exhibit before you to-night his exquisitely simple plate electric light. I have watched it burning, and know that it has a future before it, if it were only from the fact that it burns steadily for a whole week with a powerful arc light without renewal of the carbons, and yet these carbons might be put in one's pocket, and the lamp thrown about anyhow, without risk of anything getting out of order. The excessive caution of the inventor prevents my showing you this simple little lamp. My own lamp is here before you, but beyond telling you that it is very simple, and that only one magnet is employed in the regulation and separation work, I may not detain you. I now turn another tap, and the strip, through which the current passes, becomes white hot, and we call it, vaguely, an electric light. (Experiment shown.) This is the incandescent light which has been proposed for use in ordinary houses. It is, confessedly, not economical, but it is very convenient for chamber use. I now turn another tap, and you see a powerful Serrin lamp, which I mean to leave burning. You know now that we can convert electrical energy into heat and light; but the question is, how much of a result do we get for the power expended?

Professor Ayrton and his students measure at Cowper-street, 1st, how much gas is being used by his gas-engine; 2nd, how much horse-power is being actually given to his electric machine; 3rd, how much current is produced through external circuits by his machine; 4th, the resistance of these circuits. He can now calculate exactly how much horse-power is expended in any part of these circuits; and also how much light is actually given out by an electric lamp.

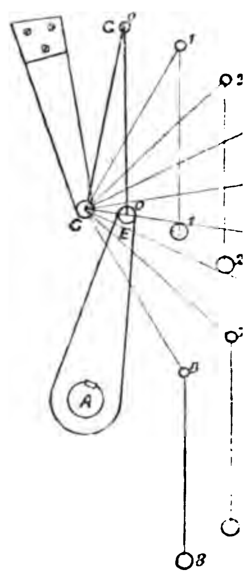
I must now try to give you an idea as to how these measurements are made. The very elegant dynamometer employed by our Chairman to measure the power which is being transmitted to a machine, I am not at liberty to describe. The plan devised by Professor Ayrton and myself is capable of being applied at very small cost to existing shafting in factories, so that the power given to any shaft may be known. A is a shaft which is to receive power. B is a loose pulley

Fig. 1.



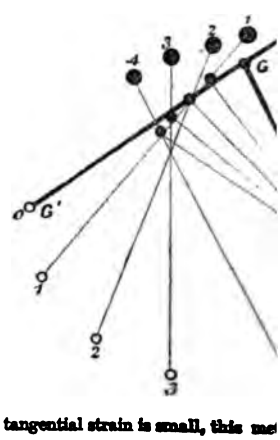
driven by a belt. C D is a wheel whose rim is fixed to the rim of B; its crooked arms are made of flexible steel, its boss being key
Evidently B can no longer be calle
if it turns it must cause the sh
the turning moment is accurately
certain amount of yielding of the s
If this yielding is known, and al
horse-power transmitted is also kn
we copy the principle of General
stead of using his elaborate system
we simply convert the tangential st
motion which is visible. This n
various ways, of which the follow
simple. A stiff arm, E A, is fixed
A; at E and at a point C of the
of two light links are pivoted, w
together at G, where there is
Evidently, if the distance C E becom
much power is being transmitted, 1

Fig. 2.



Another arrangement, giving gre

Fig. 3.



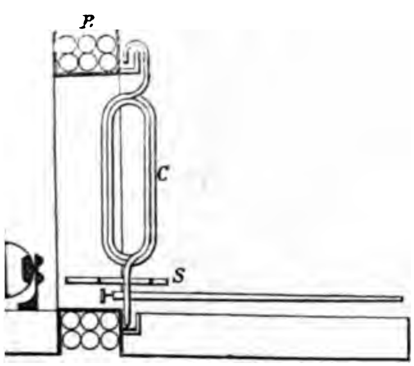
When tangential strain is small, this me
used

m the centre, and therefore the circle of escribed by it has a greater radius. The ment shown in Fig. 3 is sometimes more ent.

easure the distance of the bead from the means of a scale supported level with the Other dynamometers, which have till now use are shown in the diagrams. For ing very strong currents, such as are electric lighting, Professor Ayrton and have devised this "dead-beat" galvano-. Without going into a detailed descrip- the instrument, I may mention that sses the following great advantages. ly can the strength of any current be read once in webers, but the user can at any test his own instrument, or graduate it, as technically called, by employing only the current produced by a single Daniell's cell. result is arrived at by the device of causing weak current to circulate 60 times round the ets, while the strong current only goes round nes; a special form of commutating arrange- enabling the very same wires in the galvano- to serve for both strong and weak currents; comparisons can be made, not merely imately, but with absolute accuracy, even if res are wound on the galvanometer quite ly.

nstrument shown in this diagram may be ed in the same manner, as it is also provided same kind of commutator. We call it an

Fig. 4.

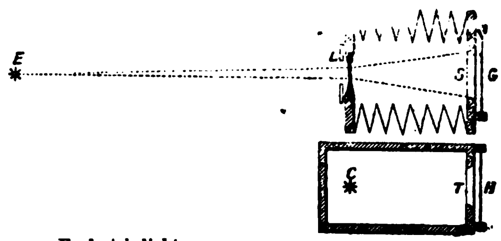


coiled cable of ten strands, which may be used in arc" or in "series," by means of the commutator, A. ble coil. spring.

e-power measurer, because its deflections are onal to the product of difference of potential ed in an electric light, into current flow- ugh the arc, or incandescent carbon, and ese deflections (see wall-sheet II., p. 459) a glance the horse-power given out at that The electro-dynamometers of Dr. Siemens Mr. Andrews are here before you, and may during the reading of the paper to measure . Mr. Andrews simply uses a steel-yard to the attraction between two coils, when the flows in them, when they are at a fixed dis- under, and he, therefore, like Dr. Siemens, s the mean square of the current flowing. struments have the disadvantage that an ordinary pair of scales has in comparison with a spring balance, viz., that a sudden temporary change in the thing weighed cannot be measured; but they have the advantage of great accuracy in the measurement of a constant effect.

To measure the light itself in standard candles, the students in the course of electric lighting, at Cowper-street, employ our photometer (Fig. 5), of which three specimens are before you, and there is an enlarged drawing on the wall. The principle

Fig. 5.—Dispersion Photometer.



E, electric light.
C, standard candle.
S and T, screens of tissue paper.
G, H, plates of green or red glass.

$$E, \propto \frac{EL^2 \cdot LS^2}{CT^2}$$

of old methods of measurement of strong lights was to weaken the intensity of illumination of a screen by taking the screen far enough away. Only in this way could the illumination of the screen by the electric light be made equal to the illumination of a similar screen by a standard candle. Our plan of weakening the light from an electric lamp is not by going forty or eighty feet away from it—for people who deal with electric lamps do not often possess a large enough chamber with blackened walls—but by letting, instead, the light pass through a concave lens. The principle is then exceedingly simple. Mr. Wormell has been making a few measurements whilst I have been talking, and I see that this electric light seen through green glass has varied from 2,214 to 2,136 candles in the last three minutes. Sir William Thomson suggested to us to make two measurements, one through green and the other through red glass, for reasons which must be obvious. Anyone who may wish it will have an opportunity of measuring the power of an electric light for himself after the lecture.

From all this you will see that perfect methods exist for measuring the power which is being given out as heat or light in any part of a circuit, as well as the power given to the electrical machine. In fact, we have a perfect measure of what is called the efficiency of our arrangement.

It is hardly necessary to tell you that every house and every street may be lighted electrically. Into the proof that, in the future, arc lamps of thousands of candle power at elevations proportional to the square roots of their powers, will be used for large spaces, and that incandescent lamps of only hundreds of candle power are suitable only for private houses; into a consideration of these statements I shall not enter, because Professor Adams is dealing with the question in his Cantor lectures. You all, in one way or another, feel that electric lighting is a foregone conclusion. But, perhaps, you were not aware that buildings may

be heated by electricity. The neighbours of this iron wire will say that it gives out a considerable quantity of heat, but whether the heating may be performed economically will depend on the story told us by the measurements which have been made. Now let me turn my tap again. I let my current pass through this insignificant little dynamo machine, and you observe that it is in motion; not only is it in motion itself, but it is driving this lathe. A machine is receiving mechanical energy outside, it converts this into electrical energy, which is conveyed by wires into the room and to the machine before you, where it is converted into mechanical energy again. I think I shall never forget the astonishment of a workman in Sheffield, who had put up a saw-bench for use at Professor Ayrton's lecture, and who was about to rehearse his part. He looked at the motionless saw, he had his hand on the wood, he saw there was a belt from a little mite of an electric machine, two wires dangled from the ceiling to the machine, and this was all. What notions of being played with came into his mind I do not know, but when, at the distant place, a water-engine was started to drive the distant machine, when the saw set off nearly at its full speed, and the two dangling wires were evidently the only methods of communication, this thoughtful workman's face expressed in full perfection the absence of all his reasoning powers. I do not wish you to lose your reasoning powers, but it is necessary that you should get thoroughly impressed with the notion that the power to drive this lathe is actually being transmitted through these limp and motionless wires.

I should like to be able to hold that machine motionless, and to prove to you that the current flowing through the wires is immediately diminished when the machine begins to move. In fact, I want to show you that this machine produces an electromotive force, which is in opposition to that of the distant machine. You see that we are just able to hold it, and now I am informed that the current flowing is 19·5 webers, whereas if we let it run, and drive the lathe and the sewing-machine and this fan, you will find that the current is diminished. It is 11·2 webers, or about half what it was before. It is not necessary to give you further examples of this transmission of power by electricity, but on account of the evident importance of the matter to the health of the community, I will give you one more, and I turn the tap, and you all see that the insignificant little machine is driving a ventilator. This ventilator might be used in a chimney in the summer time when fires are not in use, or in any suitable outlet from rooms; and pray remember that mechanical ventilation is ever so much more efficient than what is called natural ventilation, in which advantage is taken of the lightness of warm gases.

Now, what do these examples show you. They show that if I have a steam-engine in my back yard, I can transmit power to various machines in my house, and if you measured the power given to these machines, you would find it to be less than half of what the engine driving the outside electrical machine gives to it. Further, when we wanted to think of the heating of buildings and the boiling of water, it was all very well to speak of the conversion of electrical energy into heat, but now we find that not only do the two electrical get heated and give out heat, but heat i by our connecting wires. We have th sider our most important question. energy can be transmitted to a distanc to many thousands of miles, but can it formed at the distant place into mechan other required form of energy, nearl amount to what was supplied? Unfort must say that hitherto the practical an to us by existing machines is, "No; always a great waste due to the heat above. But, fortunately, we have fa measurements of which I have already the facts given us by Joule's experi formulated in ways we can understand. facts tell us that in electric machines of and in their connecting wires, there w heating, and therefore little loss. W believe, at no distant date, have gr stations, possibly situated at the botto pits, where enormous steam-engines enormous electric machines. We shall laid along every street, tapped into e as gas-pipes are at present; we sha quantity of electricity used in each h tered, as gas is at present, and it wil through little electric machines to drive to produce ventilation, to replace fires, to work apple-parers, and ma barbers' brushes, among other things, a give everybody an electric light.

Probably you think it very strange t show you the inefficiency of electric t of energy, and then make this very bol Well, the fact is, that the ordina machines in use have not been constru view to economy. They have been co show that brilliant lights and conside may be produced from small machi have, at a comparatively small cost attention to the fact that electricity is a agency. In so far they have done w the other hand they gave rise to the assumption that 50 per cent. of the power given to the generator, was mum amount which could be taken motor. The true solution of the transmission of power was, I believe, by Professor Ayrton in his British lecture at Sheffield. It had been su to transmit the power of Niagara Falls t a copper cable of enormous thick be needed. Mr. Ayrton showed that power might be transmitted by a fine if it could only be sufficiently well ins also showed that, instead of a limiting 50 per cent., the one thing preventing c the whole of our power was the mechan which occurs in the machines. He fact, how to get rid of electrical frict briefly give you our reasons. A Niagara receives mechanical power, a electricity. Call this the generator, an that wall-sheet III teaches us that th power is proportional to the electro produced in the generator, multipli current which is actually allowed to there be wires to another electric mac York, which will receive electricity, a

ical work, as this machine does here. Now, d you a little while ago, that this machine, ay be called the motor, produces a back otive force, and the mechanical power t is proportional to the back electromotive ltiplied into the current. The current, of course, the same at Niagara as at New proportional to the difference of the two tive forces, and the heat wasted is pro- to the square of the current. You see m wall-sheet III, that we have the roportion—power utilised is to power as the back electromotive force of the to the difference between electromotive d generator and motor. This reason is ortly and yet very exactly given in wall- V.

WALL-SHEET IV.

ectromotive force of generator be E; of motor total resistance of circuit be R. Then if we e horse-power received by the generator at Q the horse-power given out by motor at k, that is, utilised. H the horse-power heat in machines and circuit. C the current rough the circuit.

$$C = \frac{E - F}{R}$$

$$P = \frac{E(E - F)}{746\ R}$$

$$Q = \frac{F(E - F)}{746\ R}$$

$$H = \frac{(E - F)^2}{746\ R}$$

$$Q : H :: F : E - F$$

it more shortly still, the power wasted is ial to the square of the current flowing, he power utilised is proportional to the nd also to the electromotive force of the The greater, then, we make the electro- rces, the less is the loss of power in the ration. Perhaps you will see this better water analogy. A small quantity of ving through a water-main, may convey nount of energy, if it only has sufficient he frictional loss of power is indepen- the head, but depends very much on ity of water. In the model before you ater analogy. (Experiment shown.) A servoir, kept filled with water by a mp, which draws the water from the K K. Water flows from reservoir A to servoir, B, where it drives a turbine giving due to its head, B K. The current from rough the communicating pipe, is the ys, so long as A and B are at the same of level, and therefore the frictional ergy is always the same, whereas the ised from B, by driving the turbine, in- oportionally to the height of B above sea

ult, then, to which the above laws led Ayrton and myself was that for the elopment of the transmission and distri- electric energy it will be necessary to use achines of great electromotive force. so important must this principle become, that we believe there is a future in this direction for the employment of plate electrical machines, such as that of Holtz. Now the electromotive force of an electric machine may be increased in three ways:—1. By increased speed, as you easily see when I turn this magneto machine more rapidly. 2. By increased strength of magnetic fields. 3. By increasing the length of wire on the moving armature. Of these methods the first is most important. Now, if iron is used in the armature, since it is magnetised and de-magnetised very rapidly, its coercitive force prevents this magnetisation and demagnetisation being as complete at the high speeds I contemplated as it is at the ordinary speeds of the present day. I say this in spite of the fact shown by some unpublished experiments of ours, which imply that the magnetisation and demagnetisation of a bundle of fine soft iron wires are as complete when effected sixty times per second as when effected once per second. Besides this, a very considerable quantity of heat is developed in such rapid magnetisation and demagnetisation as does occur. The electric machines of the future will, I am convinced, be without iron in their movable parts. High speeds necessitate careful construction and the balancing of moving parts, and great attention being given to rubbing surfaces. By rubbing surfaces, I do not merely mean the bearings of the machine, but the commutator, which is rubbed by the collecting brushes. Much of the waste of energy by mere mechanical friction which occurs in electric machines occurs at the brushes; but, hitherto, other waste has been so great that this might be neglected as unimportant. But it is very important in the machines of the future. The loss of energy by friction is proportional to the number of revolutions per minute, and to the diameter of the rubbing surface. I have given considerable thought to the reduction of this friction, and have arrived at a form of commutator shown at A in the diagram (Fig. 4), which largely diminishes the loss. The parts of the commutator must be firmly fixed, but they must also be well insulated from one another, therefore they must be separated by some rigid insulator, such as ebonite, at the places where they are screwed up; hence they are necessarily far apart at these places. If they are rubbed at these places, however, there will be a great loss of power in friction, and hence they ought to be bent in towards the axis of rotation, where they may be insulated from one another by narrow air spaces, and where they may be rubbed by the brushes, with only a small waste of energy. This plan I have proved to be quite feasible. In the larger machines of the future, its importance will become much more manifest than it can be in existing machines. This frictional principle is illustrated by the model before you. Here are two surfaces, making the same number of revolutions per minute. If the same amount of rubbing occurs, you observe that when I rub the surface of larger diameter, there is great loss of energy, and the motion is stopped; whereas, when I rub the surface af smaller diameter, there is only a small loss of energy, and the motion is not stopped. (Experiment shown.)

This necessity for a great velocity of moving

coils past fixed magnets, necessitates increase of size of the armature, because for a given velocity the centrifugal force tending to burst the revolving armature is inversely proportional to the radius. For instance, here are two light wheels, made in exactly the same way. You can examine their construction at the end of the meeting. They are rotated at a different number of revolutions per minute, so that the actual velocities of their rims shall be the same. You observe that the rim of the smaller bursts in pieces, and the larger is unhurt.

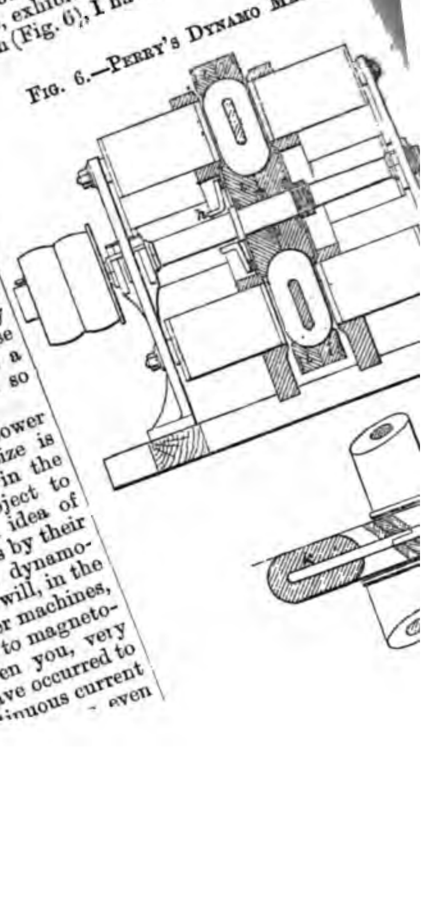
There is another important reason for increased size, namely, that of similar dynamo machines, one twice as large as the other; the larger is capable of giving out eight or more times as much energy for the same number of revolutions per minute. It would delay me too much to go into this question of size fully; but if it be remembered that the electromotive force of each moving coil is proportional to its area, then, without taking into account, increase of strength of magnetic field, which certainly occurs with larger machines, we get eight times as much effect for double the size. Electric machines of the future will then, probably, be of great size, moving with exceedingly great **velocity.**

The third method of increasing the electromotive force by having greater lengths of wire in the armature is always available, but inasmuch as every increase so produced causes a proportional increase in the resistance of the circuit, and therefore a waste by heating, this method is not quite so economical as the increase of speed method.

It is to be remembered that the lifting power produced in an electro-magnet of given size is simply proportional to the heat produced in the wire on the magnet, and if it is our object to diminish this heat, we must discard all idea of working the magnets of electric machines by their own currents. In fact, the function of dynamo-machines, like these I have been using, will, in the [illegible] be to feed the magnets of larger machines, [illegible] will give place altogether to magneto- [illegible] I have now given you, very [illegible] which have occurred to [illegible] continuous current [illegible] even

however, be quite misleading. But if [illegible] given in this wall-sheet are correct—and [illegible] nately, there can be no doubt of their corr[illegible] the practical transmission of all kinds of [illegible] all distances, the supply of large and small [illegible] of light and machine power to all parts [illegible] like London from a single centre, and a c[illegible] return to that old state in which in many [illegible] was possible to dispense with the congre[illegible] great numbers of men in large manufact[illegible] thing to be looked forward to with pe[illegible] tainty. I need hardly tell you that heati[illegible] by electricity will completely get rid of t[illegible] nuisance. I have been dealing wit[illegible] principles, and electricians will take vari[illegible] to carry out the idea put before you. In my own [illegible] machine, exhibited here, and also drawn upon this diagram (Fig. 6), I have endeavoured to carry them [illegible]

FIG. 6.—PERRY'S DYNAMO MACHINE.



made herself comfortable, and has added wealth. Adding to her wealth is an acci- ffect, perhaps, but adding to the happiness th of the poorest people in this cradle of o-Saxon race is certainly the most import- t to be effected by the wealth of Eng- do this, through the agency of electricity, rove a bad financial investment.

g this very large subject, let me speak of the applications of the above principles ve a future before them. The develop- he telephone and of telephone exchanges, ry person in London can speak directly ry other Londoner, and, indeed, with her person in the country; this, as you all quite a settled matter, although, no doubt, a little difficulties still to be surmounted. nd of a telephone wire there is a generator, eto-electro machine, which receives sound and gives out electricity. At the other re is a receiver or motor, another such which receives electric energy and gives l. We have, in fact, a simple example, f the most economical examples I know ie transmission of power by means of . Quick speeds caused by vibrations of idred times per second, and strong fields, have produced this wonderful which enables men in Paris to speak pers of their family in Marseilles. Again, t of electric railways is a part of the er subject which I have already dealt ppose you all know the general principle railways as hitherto constructed. Only e to observe large effects produced, the h is now working before you would give eas of future constructions of this kind lin railway, or the one to be exhibited [In this experiment a circular railway ed from a magneto-electric machine hand.] A generator of electricity is a large stationary engine, somewhere ghbourhood of the railway. A motor age receives electric energy by the con- ils, and converts this into mechanical rive the carriage. Even the small ex- of Dr. Siemens show that there can ibt that the introduction of electric everywhere is merely a question of id the sacrifice of much existing plant. of proof was very much needed by But the electrician sees much further; etter insulation for the conductor, and i of the above principles to hundreds of rail instead of a thousand yards; . fact, that the larger the experiment, r must be its success. He looks forward sence of a vitiated atmosphere in our nd railways. He sees that the weight or there will be no heavy locomotive ure; each carriage will have its own nd braking machinery), and the cost i, and wear and tear of permanent become less than one-quarter of what at present; he sees, in fact, all the s that will arise, when, instead of making team-engine travel backwards and for- h carriages, the carriages alone travel, am-engine is not near the railway at at case, also, all the energy at present wasted in stopping a train, will simply be given back to the generator.

I have mentioned electric lighting, and tele- phones, and railways, because I know that many of you must have expected to hear of them, but I mainly wish you to consider these appliances as examples simply of the transmission of power by electrical means. In the same way I might refer to a countless number of other appliances, giving you a mere catalogue of them; but, from the ordinary house-bell to the complicated arrange- ment by which my brother regulates the weirs on a river to prevent floods; from the time-regulat- ing luxury of certain clockmakers, to the quadru- plex telegraphy of Muirhead and Winter, they are simply methods of transmitting energy by electricity, and as such, their economical develop- ment depends on the recognition of the above principles. Take, for example, the case of ordinary telegraphy. There can be no doubt that it is absurd to fill large houses with tens of thousands of voltaic cells to work telegraph lines. But it is not sufficient for the Post-office authorities to feel the annoyance, and merely try to replace batteries with such a machine as you see before you—a machine of but one *ohm* resistance, while every mile of telegraph wire may have twenty ohms resistance. I am sure that everybody belonging to the telegraph department will be satisfied with a change that gives them one dynamo machine for all those thousands of sloppy voltaic cells; and there is no longer any excuse for further delay, since Mr. Schwendler has been perfectly successful in working long telegraph lines in India in this very manner.

When we think of electricity as an agent by means of which energy may be transferred and altered, it is natural to ask if, by means of it, energy can be stored up. If we could obtain an efficient method of storing energy, the result would be of very great importance in a variety of ways. Thus, if all the work obtainable from the tide filling and emptying great shallow basins, could be stored up, so that it might be given out steadily, and only at our pleasure; if all the work obtain- able from wind-power, which is constantly vary- ing, could likewise be stored up, so as to be readily available, a long-standing difficulty would be got rid of, which has hitherto prevented the working out of large schemes for the utilisation of these sources of natural power. And not only in these large cases, but in a countless number of other ways, is it important to possess means of storing energy. In the manufacture of gunpowder, and in many chemical operations, energy is stored up; but no such method can ever become economical. It has to be remembered, however, that electrical operations may be made as economical as we please; and however insignificant the method may appear to be just now, it may assume great importance in the future, from the fact that, with the exception of the lifting of heavy bodies to higher levels, an electrical method of storage may be made more economical than any other. Now when I charge this Leyden jar (experiment shown) you know that I store electrical energy, and I can use my stored energy at any future time if the insulation of my jar is good. Thus I have converted a small store into heat and light. (Experiment shown.) Again, I can use this store at any time to give itself out at a distant place. This is a very small store.

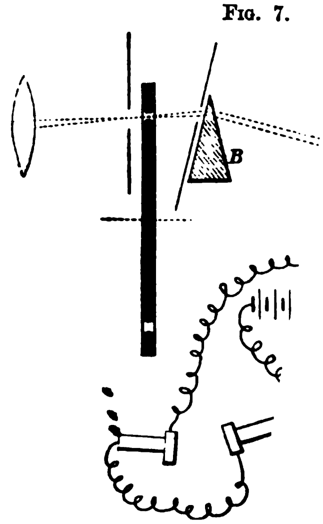
But now observe that my thermopile has been working for nearly an hour, and some time ago it had filled these two test tubes with oxygen and hydrogen. With these two gases I can produce, as you all know, a most intense heat. You all know that this lime light is produced simply through my having such a store in these iron bottles which you see before you. Remember that these gases might be kept stored up for as long as we like, and that if a windmill worked a magneto-electric machine it could produce such a store working now fast, now slow. Well, but I can take this store and convert it again into electricity with very little loss. You will see that it can produce an electric current if we have two similar metal plates in the positions you see them in, and if I connect these metal plates through the galvanometer (experiment shown), you have there evidence of a current, this deflection of the needle of the galvanometer. This current will continue to flow, and the electric energy will continue to be given out until all the store of gas disappears.

Instead of using that weak thermopile, suppose I had used this strong current produced by the outside engine, you see how much more rapidly my store is formed. (Experiment shown, in which the gases rapidly formed were used to produce an oxy-hydrogen lime light.) I grant that the elaboration of this gas battery into a compact generator sufficiently powerful to produce very large effects, is a problem of some expense for future workers; but give it to any electrician, and make it worth his while, and I believe that such a generator might be constructed in a very short time.

To introduce the next part of my subject, let me ask—Can anybody hear the sound made by a puff of air as it passes through the hole in this cardboard disc? (Experiment made.) Nobody heard it, or the difference produced when the air was stopped by the cardboard. But suppose I repeat this operation several hundred times per second, you can all hear the powerful musical note given out. (Experiment.) You see, then, that the rapid recurrence of effects may be very sensible to us, although one such effect may not be sensible. In the same way, if light streamed through one of the holes in this brass disc into your eyes, it would not produce a very striking effect; whereas Professor Tyndall says that when such a disc as this was rotating so as to let the light falling on his eyes be very rapidly intermittent, he experienced the most extraordinary sensations. Again, if I very much alter the magnetic field in this telephone, by bringing a powerful magnet near it, with great care in listening I hear the faintest sigh, due to the diaphragm settling itself into a new position, its vibrations dying away as it does so; and if I brought a small magnet near, I should hear nothing. And yet the change of magnetism which produces the loud telephonic effects which we listen to is almost infinitely smaller. Why is this? It is due to the rapid recurrence of the effects. Now you are all aware of the importance of the telephone as a method of communication; I believe that a much greater importance is in store for it as a laboratory appliance.

Here is a selenium cell through which I can pass a current of electricity from this large battery, which also passes through these two telephones, which I can hold to my ears. When light falls on ...lenium its electric resistance is diminished, and a stronger current passes. This is discovered by Mr. Willoughby Smit... cannot hear in the telephone any effe... by letting light suddenly fall on th... The difference of current produced i... case before you is only one two-thou... weber. But if I rotate this brass d... make the light fall with intermitt... hundreds of times in a second on t... I can distinctly hear a musical s... is what Professor Bell has been exhib... and it constitutes the principle of ... phone. Now to give you an idea ... ground which the use of the prin... currence is opening up in labora... let me speak of an experiment which... progress. Professor Bell spoke in hi... having tried to stop the intermitt... light of this instrument by a sheet ... like this, but he found that ther... a very faint sound from the telepho... it occurred to Professor Ayrton ... that if ebonite is transparent to so... invisible radiation, then in all prob... capable of refracting such invisible r... obtained this ebonite lens, and two ... tried. We thought the lens would ... invisible rays to a focus, but as our l... mounted, so that we could move it... itself, and as the rays are, of course, qu... so that our eyes cannot help us to focu... lens, we did not succeed in this very... periment, which the following exper... ever, shows, must ultimately be success... placed the cell at A in this diagram (Fig. ... that it gave out no sound, being bey... of the beam of intermittent light. ... prism in the position B, in which y... to our great satisfaction, a sound wa... must remember that this sound, ... obtained from light that had p... ebonite, was exceedingly feeble. T... listened was in another room, so ... any way influenced by what he s...

FIG. 7.



ciseness in detecting s... another experimenter pu...

nd taking it away again. So that there no doubt as to the origin of the faint eard. Well, the prism caused the light round, and now the question was as nuch bending it produced. We pro- o pieces of zinc plate, with slits cut You all understand, I hope, that idvanced physicists regard a metal as a opaque body, even to invisible rays, so can only pass through the slit in our zinc. placed the slit in the zinc within a short f the edge of the prism, and found a a which the rays, passing through the reached the selenium. The sound was faint. Then we searched on the selenium dge of our second piece of zinc, to find m of the cell might be covered without the sound. We found that region, and second slit there. Rays passing through were now passing through the second slit. 'as changed in position, the sound died ntaneously. Thus, there could be no doubt hat ebonite refracted that invisible beam, h nothing else is as yet known. If our en very narrow we could have measured the index of refraction, but with ts the sounds were too faint to be he centre of London; so all that we present is, that ebonite certainly ght, and its index of refraction is, uite roughly, 1·7. Now, it is some- ns that this was the rough measurement made. For Clerk Maxwell's theory, is propagated through space like an gnetic disturbance, requires the square ex of refraction, for light of very low ty to be equal to the electric specific apacity of the substance, and it has known that this electric constant for ies from 2·2 to 3·5 in different speci- e square of 1·7 is 2·89. Thus, you see urious following out of our first idea has rther backing up of Clerk Maxwell's gnetic theory of light. This and other ons which we are now proceeding rate two important things, namely— ple of recurrent effects in the use of the has opened up a new path into unex- ure; and, secondly, the laboratory worker him a hundred interesting phenomena, ıt to be investigated at once, and which ake up unless he gets more apparatus, y, and more observing eyes and working

vo years ago, it struck Professor Ayrton , when thinking how very faint musical heard distinctly from the telephone, in ud noises in the neighbourhood, that an application of this principle of re- fects of far more practical importance other, namely, in the use of musical oast warnings in thick weather.* You hat fog bells and horns are an old that they have not been particularly successful, but our scheme was of a somewhat different kind. In northern Japan, where fogs are the rule and not the exception, which they are in England, and where changing currents of more than six knots are common off many dangerous parts of the coasts, ship-masters are very much in the habit of using their steam-whistles, listening for the echo from the steep coasts, and judging from the interval of elapsed time what is their distance from the coast, and what is their position. But they find that on many foggy days they can, and on other foggy days they cannot use this method, because they may hear no echo, although quite near the coast. Now, it seems to be forgotten by everybody that there is a medium of communication with a distant ship, namely the water, which is not at all influenced by changes in the weather. At some twenty or thirty feet below the surface there is an almost perfect calm, although there may be large waves at the surface. Suppose a large water-siren like this (experiment shown) is working at as great a depth as is available, off a dangerous coast, the sound it gives out is transmitted so as to be heard at exceedingly great distances by an ear pressed against a strip of wood or metal dipping into the water. If the strip is connected with a much larger wooden or metallic surface in the water the sound is heard much more distinctly. Now, the sides of a ship form a very large collecting surface, and at the distance of several miles from such a water siren as might be constructed, we feel quite sure that, above the noise of engines and flapping sails, above the far more troublesome noise of waves striking the ship's side, the musical note of the distant siren would be heard, giving warning of a dangerous neighbourhood. I have no time now to tell you of the small experiments we have made in this direction. This electric-bell sounds only very faintly when in water, and yet we have been able to hear it at the distance of sixty feet along a trough of water in a place filled with the noise of much heavy machinery. We took this water siren to Hastings for a trial in ordinary boats, but the weather was too rough at

FIG. 8.—SUBMARINE COAST WARNING.

An electro-magnet, with vibrating armature, giving out loud musical note.

* reading of this paper, my attention has been drawn the *Engineer*, of Jan. 28th, 1876, from Mr. H. T. who there suggests the use of submarine sirens as a. Since the idea struck Mr. Ayrton and myself, we ndering how it escaped attention so long. We now he lighthouse authorities have made no efforts in the to carry Mr. Humphrey's idea into effect.

the time for boats to go out; and, therefore, the experiment had to be postponed. We have constructed the arrangement shown full size in this diagram, in which currents of electricity are sent from a distance sufficiently rapidly intermittent through this electro-magnet to give the natural period of vibration to this armature when in water (Fig. 8.) Whether this will prove successful or not we do not know, but we feel sure that the idea is to be carried out electrically, the source of sound being a motor worked by a generator on the nearest coast. In considering this problem, you must remember that Messrs. Colladon and Sturm heard distinctly the sound of a bell struck under water at the distance of nearly nine miles, the sound being communicated by the water of Lake Geneva.

Another application of the principle of recurrent effects, which may, indeed, be regarded as the earliest of such applications is this multiple telegraph of Mr. Elisha Gray, which my friend Mr. Graham has been kind enough to put in working order, so that it may be worked from this table to the telephones hanging against that wall. About this telegraph which allows a great number of messages to be sent through an ordinary telegraph wire at the same time, Sir William Thomson wrote to me in terms of high eulogium when he first examined it at Philadelphia. At present I believe that the quadruplex system is more favourably looked upon because it has succeeded better in practice, but I am inclined to think that in the distant future it may possibly have enormous development.

In this paper I wish I could bring in, as illustrations of the few great principles which are really the important factors in the future development of electrical appliances, the microphone and all the instruments which have been derived from it, but even to refer to them would take far too much time. I would end by speaking of two appliances which are of quite a different species, namely, Mr. Edward Bright's method of de-electrifying woollen yarn, and of a contrivance for seeing by electricity. In the manufacture, the woollen yarn becomes electrified by friction, and has hitherto lost its electricity very slowly, requiring to be stored for many months in damp cellars before it got rid of its electricity. Until lately, nobody seems to have suspected that it was electricity which caused the fibres to stick out on all sides of the yarn instead of staying in an interlaced condition. It was found to occur most in dry weather, and was vaguely put down by Englishmen to "the weather." So very annoying was this in a dry climate, that although Bradford men and Bradford machines were taken to America, only two months in the year could really be devoted to the manufacture. Now, we have here some wool-staple in the air which is being electrified by this plate machine. You see how the fibres repel one another and remain in this state. You observe, however, that these other fibres we try vainly to electrify because they are in a partial vacuum, and electricity escapes from them as rapidly as it is formed. I will allow air to enter this air-pump receiver, and now, when the machine is worked, you see—(Experiment shown)—that these fibres retain their electricity. The principle that a partial vacuum is very conductive has long been known to electricians, but the remarkable saving in woollen manufacture, effected by applying a knowledge of the principle, was left for Mr. Bright. Mr. Bright's plan of operations is to have chambers ... partial vacua may be produced. He wh... trucks of electrified bobbins of yarn i... into the chambers, and takes them out very soon, ... fied, thus performing, in a few minutes, ... an operation that used to be badly performed, i... in a ... manner, in half a year. Can we doubt t... that, when boys obtain, in all elementary school... knowledge of electricity, there will be ... additions to the number of electrical appliances?

And now let me come to the last of the developments of electrical appliances, sti... somewhat in the future. A picture ... an aged couple at home seeing on the ... drawing-room wall an image of their children ... lawn-tennis out in India, and of their ... with some of them by telephone, first led ... Ayrton and myself to think of this matter ... showed that it was feasible, in a letter to ... and in the *Times* about a year ago. The ... of the method described by us was do... we therefore proved it at a meeting ... Physical Society four weeks ago. I ... it before you in a slightly different form ... pose that place is York, and this is L... I have a little selenium cell at York on a ... part of this picture, and at London I can ... at a corresponding place on this screen a square ... light; and suppose that the illumination of ... square is governed by a little movable ... which is attached to the needle of a galvanometer. Now when light falls on the selenium ... York, an immediate change occurs in it, so ... more current flows to London, and this opens ... shutter. The London square is then bright, ... the York selenium is in bright illumination. ... the York selenium is in shade or darkness, ... that the London square is in corresponding ... or darkness. (Experiment shown.) Now ... that we form an image of this girl wi... skipping rope at York, and cause a selenium ... at York to travel across her image, and ... that this mirror at London moves so as ... the illumination which passes the shutter to ... this London screen isochronously—an op... performed in several telegraph instruments ... whenever this cell reaches a dark, or ... bright place in the image at York, there ... darkness, or shade, or brightness at the co... ing place in London. And now suppose ... motion is effected rapidly enough, you ... aware that if the shutter is only quick ... its answering motions, the image of the ... the screen at York traversed by the cell ... faithfully reproduced, and will remain ... retina at London as a distinct picture in bl... grey, and white, just like a photograph. ... then, perhaps, forty such cells as this all ... in the way spoken of, or a smaller number ... on a radial arm, it would actually be possible ... show at London, not merely an image of a ... York, but an image of a girl skipping. You ... perhaps, understand better this principle fr... model. Here is a path of black and white ... at York, over which this selenium cell be ... travel. We have continued the images to the ... above, simply to let you know when the cell is ... image of a dark place, and when it is in the ...

Fig. 9.

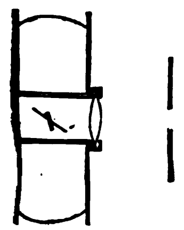
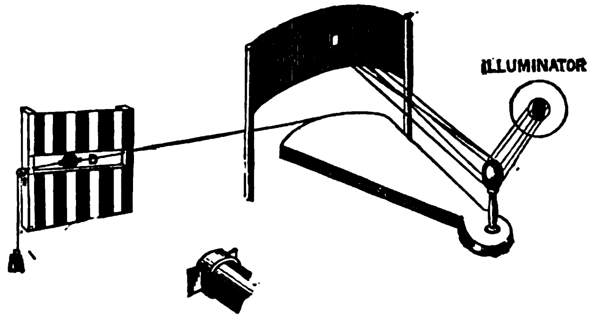


Fig. 10.



bright place, so that you may be able to say ...er there is a faithful reproduction at London. ...two frames are really tied together by this string to make them move isochronously. In ...ce, I need hardly say that this function will ...rformed in another but quite as feasible a ...r.

...cell at York is in a black part of the picture; ...serve no light on that part of the screen in ...n. The cell at York is in a bright part of ...ture; the corresponding part of the screen ...don is bright. And so we find that, as the ...es successively through dark and bright ...so the corresponding parts of the screen at ...a are made dark and bright. (Experiment ...) Our shutter is not yet sufficiently dead- ...r us to make this motion rapidly.*

...I hoped to be able to show you to-night ...velopment of this method, by using what ...ve called the Japanese-mirror principle. ...re shown† that the most minute effects on ...ks of metal mirrors, effects quite invisible ...xamining the polished surface of the mirror, ...ry visible in the reflection of a divergent ...of light. Such effects, we believe, we can ...e by electro-magnets arranged radially ...l a circular mirror and rotating with it. ...adial arrangement of magnets will move ...ronously with a radial arrangement of corres- ...ng cells. The principle, however, is exactly ...ne as that shown by this model, only we know ...e change of curvature at a point in a mirror ...ey changes of magnetic effects more rapidly ...his shutter does.

...d hoped to be able to present to you the ...which Mr. Shelford Bidwell has proved to ...sible, of reproducing in shaded lines on ...by electro-chemical decomposition, a picture ...istant stationary object. I understand, ...r, that Mr. Bidwell has been asked to ...paper here, when he will exhibit the model ...made.

...y paper read here a year ago it was the im- ...ce of giving artisans facilities for obtaining ...ally exact knowledge in science that I ...lly laid stress on. To-night I have desired, ...o show what benefits our country would receive from an exact knowledge of electrical magnitudes, and of the fundamental laws of electricity being more widely disseminated, and, second, how the principle of recurrent effects may be employed to assist our senses.

* ...r the reading of the paper, it was found that even with the ...was nearly possible to make the motion fast enough for the ...by the retina of a complete image of the path traversed.

† ...Proceedings of Royal Society, No. 191, p. 127, 1878.

DISCUSSION.

The Chairman said, in the usual course of things he should have liked to invite discussion on some of the many points referred to in this most interesting paper, but it was now so late, that although it would be permissible for any one to make an inquiry, it would be impossible to have a full discussion. He, himself, should like to ask a question on one point, which was this—Did he rightly understand Professor Perry that the whole power of the Falls of Niagara might, under some circumstances, be transmitted to New York through a single telegraph wire? It appeared to him that the enormous difference of potential at the two ends of the wire, and the large quantity of electricity passing, would cause more than sufficient heat to fuse the wire.

Professor Perry said his notion was what had been stated, and that he believed was the logical mathematical deduction from the fundamental laws of electricity; and in this Professor Ayrton agreed with him. It was the current of electricity passing through the wire which produced the heat, and if only a very small quantity passed through it could not be fused. Now the quantity of electricity was only one factor, the energy transmitted was equal to the potential $\times$ quantity. Suppose the one were 1,000,000, and the other $1,000,000 \times 1 = 1,000,000$; if the one became $\frac{1}{2}$ and the other 2,000,000, the product was equally 1,000,000; and if one factor became $\frac{1}{1000000}$, and the other 1,000,000,000,000, the result was still 1,000,000; the product was always the same, and the smaller factor might be made as small as you pleased. That was their contention, and though it was very probable they might never be able to produce practically the perfect insulation required, he believed the theoretical deduction was sound.

Professor Ayrton said the lecturer referred to the difference of potential, not at the two ends of the wire which transmitted the power, because, of course, where there was much difference of potential at the two ends of the wire, there would be a tolerably large current passing, but the difference of potential between the wire at each end and the earth. The difference of potential between the two ends of the wire would be exceedingly small, and, therefore, the current flowing through would be exceedingly small; but the difference of potential between any parts of the wire and the earth would be extremely large, so that much work could be

put in at the generating place, viz., Niagara, and much work would come out at the motor place, viz., New York, but the current flowing through the wire, which depended upon the difference of potential between the two ends, would be exceedingly small, because, though each would be very high, they would be nearly equal to one another. Consequently the waste of energy in electric friction would be small.

The Chairman said he thought this explanation had thrown considerable light on the point referred to, which was one of great practical importance. He begged to move a hearty vote of thanks to Professor Perry for his very interesting and instructive lecture, and for the experiments which had accompanied it.

The vote of thanks was carried unanimously, and the proceedings terminated.

MISCELLANEOUS.

FIRES IN THEATRES.

The following remarks on the necessary arrangements for public protection from fires and panics at theatres for public protection from fires and panics at theatres
...ther public establishments, are taken from the
... Edwin Chadwick, C.B., to the Committee
... the Prevention of Fires and on
...olis, dated July, 1877,

speciality of service applicable to the pur
the highest architectural practice. T
fire necessarily accompanies the elab
now required in such edifices for warm
and ventilation. The application of s
pose, to the Houses of Parliament, b
the late Dr. Reed, Sir Goldsworthy
Dr. Percy. In Paris it was led
Voir le Blanc, and now by General
tute, and Mons. Charles Joly. T
are becoming elaborations of ne
The new Grand Opera at Vien
miles of pipe to be regulated f
warmth, and between five and s
to be regulated for its lighting,
cation from a central office t
conditions of all parts of the th
The provisions against fire, i
it, were correspondingly elab
of science, in the larger co
in their degree to lesser buil
should be submitted, be mo
them in connection with th
general police service, wh
such consultative scientifi
the Houses of Parliamen
executive service of ra
public protection."

PRESS

Mr. C. Shaler Smi
to the American Soci
of many ye

Marshfield tornado, he had yet to find a storm swath the width of pathway, wherein the force exceeded per square foot, was more than 60 feet wide. St. Charles tornado is a case in point. This whirl- a swath about 1,000 feet wide for fourteen and destroyed over three hundred houses, a force of over 84 lbs. per square foot at its maximum effort. It crossed the middle span of St. Charles bridge nearly at right angles, and a pressure of $52\frac{1}{10}$ lbs. per square foot in up and crushing a barrel of tar, which stood on in the path of the vortex. The width of the distinctly marked on the span by the circle the tar was spun around, the wreckage left the points at which it ceased to destroy the This width was thus shown to be slightly over guided by this, Mr. Smith was subsequently to locate the path travelled by the central throughout the entire length of the storm swath. itself was uninjured, although it was only to withstand 30 lbs. per square foot, strain of 20,000 lbs. per square inch on This span was 320 feet long, 30 depth, and the top chord was 120 feet water. He considers it very unlikely that a of over 200 feet span will ever be exposed to a of more than 30 lbs. per square foot, acting same direction over its entire length. Next, a ded passenger train and the heaviest possible train will leave the track at the respective of $31\frac{1}{4}$ and $56\frac{1}{2}$ lbs. per square foot. If the proportioned at 15,000 lbs. per square inch, and pressure of 30 lbs. per square foot, they be within their limit of elasticity at the when the train is blown from the track in either struction of the span will then taken place, if om the effect of derailment; to resist which strength in the wind bracing will be of no Next, if there is no tension in the pier columns lbs. wind pressure is reached, and these are properly spliced and anchored, as per speci- there will be an ample margin of tensile in any case where this pressure may be ex- . Last, in view of the comparative rarity of treme strains and the consequent slight fatigue the iron is exposed, the high stresses imposed and bracing are perfectly legitimate.

HE WAX PALM IN PERNAMBUCO.

amanba palm (*Copernicia chifera*) seems to be more important plant in some parts of Brazil generally supposed. In Pernambuco the plant abundant, and the uses to which it is numerous. The wood, for instance, is used ng, both as beams or rafters, and as laths upon support the tiles; the fruits are used for feed- e, and the leaves are used for making hats and valuable medicine is obtained from the roots, as recently been brought to notice in this From the shoots or leaves a wax is obtained; urpose they are cut before they unfold, dried in powdered and boiled, the wax rising to the the water. This wax, it is stated, is not pro- anything like the quantity that it might be. m, in a recent report of her Majesty's Consul mbuco, that the export of this wax during amounted to 18,668 kilos., valued at £758; in o 171,980 kilos., valued at £6,957; in 1877-78 89,482 kilos., of the value of £3,168; and in o 1,542 kilos., valued at only £61. By far the rtion of this wax finds its way to this country. m that the decrease during the last year was famine and drought which so severely crippled ry in the province. It is not a little remarkable that, at a time when roasted date stones are proposed as a substitute for coffee, we should also learn that the stones or seeds of the Camanba palm, when roasted, are used in Pernambuco as coffee.

THE NEW EDDYSTONE LIGHTHOUSE.

The following particulars respecting the progress of the works at the new Eddystone Lighthouse are given by the *Architect*:—

"The masonry up to the fifty-second course, which is 80 feet above low-water mark, has been completed. It is now on a level with the light of the old tower; thus the new tower already intercepts the light from the old tower over a very perceptible area, viz., 12 degrees near the reef. This would soon be passed over by a ship, but at five miles distance there would be a mile of darkness on a true south-west course. It was intended in the original specifications to provide for this interception by placing a second light in the new tower at the same level as that in the old tower, so screened as to be visible only within the limit of the dark arc. There was also to have been a temporary bridge from one tower to the other, so that the second staff of light-keepers might have communication between the two towers. This, however, is not to be carried out, and the Trinity Corporation have given public notice to mariners that there is such a dark arc, and the cause of it. The fifty-first course, which was laid a few days ago, is a floor course, and completes the fourth apartment above the well. The room just completed is the crane-room, and is provided with two doors besides a window, one facing south and the other north, so that stores may be taken in from either one side or the other, according to the state of the weather. The three rooms below this will be occupied as oil and general store rooms. The room immediately above the crane-room was to have been occupied by the white fixed subsidiary light, which is to cover the reef of rocks known as the Hand Deeps. The rocks bear from the Eddystone Lighthouse three and a quarter miles in a direct line between it and Lool Island. At low water there is a depth of four fathoms of water upon them. Although this would be ample for ordinary craft in fair weather, yet in rough weather it may go ill with even a small vessel in the trough of a sea, much less one of a larger class, or, perchance, an ironclad. This subsidiary light will only be seen within the area above named, and when in the vicinity of danger. It is now intended that this subsidiary light shall be placed a room higher, so changing places with the living room. These modifications, together with the preparation of the light itself, are being carried on in the yard at Oreston, and afford occupation for the men when they are not able to work at the rock. In external appearance the new tower will be a complete alteration from the old both as to height and colour, being nearly as double as high, and of uniform granite, like the breakwater lighthouse. The light itself is to be a modification of the plan recommended by Sir William Thomson. Instead of a fixed white light, as at present, it will be oscillating. The light will be a powerful white double-flashing half-minute light, showing two successive flashes of about $2\frac{1}{2}$ seconds' duration, divided by an eclipse of about four seconds, the second flash being followed by an eclipse of about 21 seconds. The light will be visible all round the horizon, but from its more elevated position it will be seen in clear weather $17\frac{1}{2}$ miles, and its field of visibility will overlap that of the Lizard, instead of there being, as now, eight miles of darkness. Out of the 2,200 stones, of which the tower will consist, over 1,800 are already in position. At the present rate of progress, therefore, it is probable that next autumn's excursionists will witness the completion

of the tower, and mariners are informed by public notice that the new tower will be ready for the exhibition of a light early next March."

COCA (ERYTHROXYLON COCA).

In Mr. Markham's "Peruvian Barks," recently published, he has given the results of his own observations, and collated that of other travellers, respecting this substance, and to this account we are chiefly indebted for the following facts:—

"Coca," the "beloved narcotic of the Peruvian Indian," was first named botanically through the labours of Joseph de Jussieu. The history of this noted botanist is a melancholy one. He left France in 1735, in the ever memorable expedition of La Condamine, and after M. La Condamine left South America, M. Jussieu continued his botanical researches, making numerous journeys on foot, notably those to the Cinchona regions. The results of fifteen years labours were contained in certain cases of dried plants, &c., and a native servant at Buenos Ayres, thinking these cases contained money, stole them, and this loss had such an effect on poor Jussieu that he returned to France in 1771 deprived of reason.

The coca is the great source of comfort and enjoyment to the Peruvian Indian. It is to him what the kava-kava is to the South Sea Islander, the betel to the Hindu and Malay, and tobacco to the rest of mankind, but with this difference it produces invigorating effects. The Peruvian Indian looks upon coca with veneration. In the palmy days of the Uncas or Yncas, coca was sacrificed to the sun, the high priest or Huillac Umu chewed it during the ceremony, and before the arrival of the Spaniards, coca was used in lieu of money. After the Spanish Conquest, much was done to prescribe its use, because as a Council of Bishops held in 1569, said it was a "useless and pernicious leaf, and on account of the belief stated to be entertained by the Indians, that the habit of chewing coca gave them strength, which is an illusion of the devil." Coca, indeed, from its popularity, being used by about eight millions of people, has always had a great commercial importance, and one Viceroy, Don Francisco Toledo, issued no less than seventy ordinances concerning coca in the space of four years (1570-1574).

The coca plant is a shrub of four to six feet high, with straight and alternate branches and leaves like those of the tea plant, and is cultivated at elevations of from 5,000 to 6,000 feet above the level of the sea in the warm valleys of the eastern slopes of the Andes. Here the only alternations of climate is from wet to dry, frost is unknown, and it rains more or less every month of the year. The seeds are sown on the surface of the soil as soon as the rainy season commences, and begin to sprout in a fortnight, being carefully watered, and protected from the sun by a thatched roof. The following year the seedlings are transplanted in a soil carefully broken up and freed from weeds. The ancient custom was to raise the plants in terraces on the hill sides, but now plantations on the level ground are resorted to, although Indians aver that plants raised under the former conditions yield a much superior quality of leaf. At the end of 18 months the first harvest is ready, and the picking of the leaves, performed by women and children, is very carefully proceeded with, so as not to injure the young and still tender shoots. As soon as one crop of leaves is removed, if well watered, and the ground carefully weeded, another crop is ready in about 40 days. A plant continues to yield for about 40 years and Dr. Poeppig gives the profit of a coca plantation as about 45 per cent. Each picker carries a piece of cloth in which the leaves, plucked one by one, are placed. These leaves are then take drying yard, formed of slate flags. Here t are spread out in thin layers, and careft in the sun. Too much exposure to the s the flavour of the leaf, and if heaped too much the leaves ferment and become fœtid. A dried, the leaves are packed in bags made c leaves, with an outside covering of cloth, c tightly in larger parcels of about 50 lbs. each.

In the Sandia district of Caravaya, two v coca are recognised, the Ypara and the Hatu the latter having a larger leaf than the forme

In Bolivia, coca is treated as a Government 1 and the right is generally farmed out. In brought into that country's exchequer a sum c dollars. The whole yield of coca in South A estimated at thirty millions of pounds. C deteriorates in keeping, and Indians treat it as if kept longer than seven months.

Such is the faith in coca, that it is believed man can but taste a coca leaf when placed on hi his future bliss is assured. No Indian is wi *cuspa* or coca bag made of llama cloth, and th a day, sitting down, he takes leaf by leaf and up in his mouth till he forms a ball. Then a small quantity of powder consisting of ca potash, made by burning the stalks of the qui mixed with lime and water, he goes on his way The use of coca is widely spread. The sh the cold slopes of the Andes has but th little maize as his sole nourishment, and t messenger looks to it as his solace and As to the properties of coca, it seems ve that it allows of a greater amount of fatig lesser amount of nourishment, and prevents of respiration in ascending steep mountain s has an agreeable and aromatic taste, accomp slight irritation, which excites the flow of t When made into a tea, in taste it is like tha tea, and effectually prevents drowsiness. externally as a poultice, it moderates rheuma brought on by exposure to cold and wet, and headache.

Mr. Markham chewed coca leaf very frequ states that he found it to produce an agreeabl feeling, that he could endure longer abstine food with less inconvenience, and that when u could ascend precipitous mountain sides with a lightness and elasticity, and without losing br also considers it the least injurious of all other stances, even when taken in excess, and at time the most soothing and invigorating.

NOTES ON BOOKS.

An Agricultural Class-Book. for the use of S South India. By William R. Robertson. 1880.

The author, who is the Superintendent of G Farms in the Presidency of Madras, has here p book, which is intended not only to enabl school to qualify themselves for the Agricult tion of the Upper Primary and Middle School tions, but also to give information to those e agricultural pursuits. The subjects dealt witl the preparation of land for cultivation, tilla ments, and tillage operations, manures, irriga farm crops, and farm stock. The author point much of the suffering in South India from sc famine is due to bad farming, and what need tl superseding the tillage implements now in u proved labour-saving tools.

ng; a Text-book to the Practice of the Art or of the Plumber, with supplementary chapters House Drainage, embodying the latest improve-. By William Paton Buchan. Second edition. on: Crosby Lockwood and Co., 1880.

irst edition of this little book was published in ith the object of affording a handy text-book for rentice plumber, but the present one has been d somewhat, in order to make it useful to a wider The volume is divided into thirty-one chapters different subjects connected with the plumber's The roof, with its gutters and ridges, is first ed, then comes the arrangement of the pipes, the sets, the baths, and the cisterns; the more questions of water supply are then treated, and he is completed with remarks on disinfectants, nd general drainage. The author points out how nt it is that the occupant of a house should and the ramifications of pipes, which, if badly l, may expose him to such baneful influences. tes, "The present is the era and grand oppor- f plumbing, and in order to bring it to perfec- th the architect and the plumber must work in r, and together do whatever in them lies to such a result as will be both creditable to them, easing to the community at large."

GENERAL NOTES.

ation of Naval Architects.—The meetings of ution were held in the Rooms of the Society of Arts, esday, 6th inst., Thursday, 7th inst., and Friday,

s Light in Coal Mines.—The Swan electric light the *Electrician*, to be "laid on" to Mr. John Earnock Colliery, Motherwell, and will extend to ottom, the roadways, the station where the under- ngine is placed, and possibly the miners' working

ric Light at the Cannon-street Station.—The ght was used for the first time at the Cannon-street on the evening of the 31st ult. The arrangements sist of Gramme machines and Brockie arc lamps, work has been carried out by the British Electric mpany. Eight powerful lights of 6,000 candles each nded from the roof of the station at a height of rty feet from the platforms, and there are two lights the station. There are two circuits for the ten lights, n each, and the current for each circuit is produced f the large new type of Gramme machines recently ed by the British Electric Light Company, which number of arc lights in series.

ressed-air Clocks.—A Bill is now before Parlia- give London the benefit of the system of compressed- s, which has been extensively established in Paris. pressed-air clocks consist of a new and simple con- of the works of the ordinary timepiece, by which all s of any city or town, however much separated and rom each other, can be governed and wound up and d by means of a pneumatic air current and connect- hanism that secures their regular going and their synchronisation. The movement can be applied to ing clocks or timepieces, wherever placed, and there either one central motor or several, according to the ach municipality. If the system were adopted in and the environs, as proposed by the Bill already to, which has the consent and sanction of the City ies and the Metropolitan Board of Works, the result e that every clock embraced within the system, no where situated, would always indicate precisely the ne of the day or night. The number of stations pro- r the metropolis by the promoters of the Bill now Parliament is ten. The maximum charge for public s not to exceed 12s. 6d. per annum.

Plant Labels.—Mr. W. Ingram, the gardener of the Duke of Rutland, writes to the *Gardeners' Chronicle* on this subject:—"I hope the very liberal prize offered by Mr. Wilson for a good plant label will stimulate the inventive faculties of gardeners and others, and that we shall at length secure something on which to register the names of plants prominently and distinctly, and thus be saved from the annoyance of obliterated names that has too often followed from the use of the old easily made and quickly perishing label of wood. As our plant collections increase—and they are increasing rapidly—we feel the want of a fresh label more and more, and I trust that Mr. Wilson's example will be followed by others, and a second and third prize offered for meritorious inventions in plant labels. I have tried many kinds, and have suffered the disappointment that has doubtless attended the efforts of the donor of the prize in his search for a permanent and readily-made label. Wood, paint, and pencil must be abjured for all but temporary purposes. Zinc and indelible ink, which seemed to offer some advantages, have disappointed me. Terra-cotta has crumbled under the powers of frost and wet; even iron corrodes, and, good as it is for some purposes, cannot readily be made use of. We want the medium that offers the facilities given by wood, paint, and pencil, and yet gives the durability of a record inscribed on iron—something that can be quickly fashioned and inscribed, and when done will remain impervious to the action of weather—that will bear rough treatment—that a foot cannot crush, nor the wind nor frost remove, and, with all this, is not obtrusively large—no more conspicuous than the plant it names. Then we want distinctive labels for the various cultivated plants, small and neat for pot plants, strong for shrubs and herbaceous plants, plain and easily read, and readily affixed for fruit trees; and one prize will scarcely include all these. Surely the authorities of botanic gardens might co-operate with Mr. G. F. Wilson in his laudable endeavour to secure a good plant label."

Seaweed Jelly.—The seaweed, *Arachnoidiscus japonicus*, which is used by the Japanese and Chinese to pack porcelain and other articles for exportation, is said, by the *Journal of Applied Science*, to be made use of in France for the purpose of making a spurious fruit jelly. When placed in a tumbler of water, it absorbs the water in a few minutes; then a number of shoots grow, and constitute a jelly nearly as transparent as the water from which it is made. The jelly is easily sweetened with glucose, and cochineal or other colouring matter is added with equal facility to imitate the colour of the fruit. The perfume and the taste were the only real difficulties that remained to be overcome. After considerable study, it was discovered that, by using a mixture of certain ethers with tartaric acid, glycerine, &c., a perfect imitation of the odour of raspberries was produced. By putting a little of this essence to the seaweed which has been allowed to develop itself in water, a substance is obtained which has the consistency of fruit jelly, though no fruit has been used, which is sweet, though no sugar has been employed, and which has the colour and fragrance of raspberries, though altogether destitute of that fruit. When this ceases to please, another very good fruit flavour is produced by treating castor oil with nitric acid. The jelly still retains a little of the fibrous nature of the plant, and has a tendency to split and fall to pieces, instead of forming adhesive lumps. Examined by the microscope, it has no resemblance to the jelly made from fruit. Then, as the jelly must be coloured, it is easy enough to discover the presence of an artificial dye. Without resorting to the laboratory, it suffices to dissolve a little of the suspected jelly in some tepid water, and dip a white silk ribbon in the solution. If it is a natural jelly, the ribbon will only be a little soiled; but if the jelly has been artificially coloured, the ribbon will also be coloured.

Purifying and Bleaching Sponges.—M. Blondeau gives the following receipt:—The sponges are first washed in tepid water, and then in a solution of hydrochloric acid (5 cubic centimètres = 0·3 cubic inches, to 1 litre = 1¾ pint), which frees the pores from carbonate of lime. To bleach them, they are immersed, for 24 hours, in a solution composed of five parts of hydrochloric acid to 100 of water, with the addition of six pints of hyposulphate of soda. In this way sponges may be bleached much more effectually and rapidly than with sulphurous acid.

New Application of the Sub-products of Coal-tar.—Mr. Sanders, of St. Petersburg, has succeeded in producing from the heavy oils of coal-tar, a new substance which, in

many cases, takes the place of india-rubber with advantage. It is prepared in the following manner. A given weight of a mixture in equal parts of wood oil and coal-tar oil, or of coal-tar and hemp oil, is heated for several hours, at a temperature of about 318° Fahr., so as to disengage the injurious substances and increase the viscosity of the mass, until it may be drawn out in threads. A second quantity, equal to the former, of linseed oil, preferably thickened by boiling, is now added, and also from one-twentieth to one-tenth per cent. of ozokerit with a little spermaceti. In the meanwhile, the mass is kept at a uniformly high temperature for some hours, when from one-fifth to one-half part of sulphur per cent. is added, after which the product is moulded or otherwise worked in the same manner as india-rubber. The proportions of the three oils named above may be varied so as to obtain a harder or a more elastic substance, as may be required. The product is elastic and tenacious, standing the weather better than india-rubber, and is not deteriorated by great pressure or a high temperature. It is said to be specially suitable for the insulation of telegraph wires, and may be employed alone or mixed with india-rubber or similar resinous substances.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at eight o'clock:—

April 27.—"Five Years' Experience of the Working of the Trade Marks' Registration Acts." By Edmund Johnson.

May 4.—"Buying and Selling; its Nature and its Tools." By Professor Bonamy Price, M.A. Lord Alfred S. Churchill will preside.

May 11.—"The Manufacture of Glass for Decorative Purposes." By H. J. Powell (Whitefriars Glass Works). William Spottiswoode, LL.D., P.R.S., will preside.

May 18.—"The Electrical Railway, and the Transmission of Power by Electricity." By Alexander Siemens. Dr. Siemens, F.R.S., will preside.

Foreign and Colonial Section.

Tuesday evenings, at eight o'clock:—

May 10.—"Trade Relations between Great Britain and her Dependencies." By William Westgarth.

Applied Chemistry and Physics Section.

Thursday evenings, at eight o'clock:—

April 28.—"Impurities in Water, and their Influence upon its Domestic Utility." By G. Stillingfleet Johnson, F.C.S. Allen Thomson, M.D., F.R.S., will preside.

May 12.—"Recent Progress in the Manufacture and Applications of Steel." By Prof. A. K. Huntington.

May 26.—"Telegraphic Photography." By Shelford Bidwell. Prof. W. G. Adams, F.R.S., will preside.

Indian Section.

Friday evenings, at eight o'clock:—

April 29.—"The Building Arts of India." By General Maclagan. Andrew Cassels, Member of the Indian Council, will preside.

May 13.—"Burmah." By General Sir Arthur Phayre, G.C.M.G., K.C.S.I., C.B.

Members are requested to notice that it may be necessary to make alterations in the dates of the above papers.

Cantor Lectures.

Monday evenings, at eight o'clock:—

The Fourth Course will be on "The Art of Lace-making," by Alan S. Cole. Four Lectures.

Syllabus of the Course.

Lecture III.—May 2.

Fringes. Twisted thread-work in E 15th century. Early designs for plaitec threads. Italian, Flemish, French, and l lace. Laces of primitive design.

Lecture IV.—May 9.

Resumé as to styles of design in ha Traditional patterns. Sketch of the d inventions for knitting and weaving thre lace. Differences between machine an laces. Modern hand-made laces at Bu Honiton, &c.

This course will be illustrated by speci Diagrams and photographs enlarged will means of the lantern and oxyhydrogen li

The Fifth Course will be on "Colo and its Influence upon Various In R. Brudenell Carter, F.R.C.S. Tl May 16, 23, 30.

MEETINGS FOR THE ENSUING

Monday, April 18th...Asiatic, 22, Albemarle-st

Tuesday, April 19th...Pathological, 53, Berner street, W., 8½ p.m.

Wednesday, April 20th...Institute of Bankers (the London Institution, Finsbury-circ Mr. John Smith, "The Government I
Meteorological, 25, Great George-street, Dr. Wladimir Köppen, "The Frequen of Rain." 2. Mr. G. M. Whipple, "I ments made at the Kew Observatory George's Barometers." 3. Mr. G. M. Discussion of Mr. Eaton's Table of Height at London, with regard to Per
Archæological Association, 32, Sackv 8 p.m. Mr. H. Syer Cuming, "Seal Templars."

Thursday, April 21st...Mechanical Engineers, street, S.W., 7½ p.m. Reading and dis ing papers:—1. M. Le Baron Clauzel, Special Reference to Ship-work." 2. Kennedy, "Results of Experiments or made for the Institution of Mechan 3. Mr. W. W. Beaumont, "Thrash 4. Mr. J. J. Tylor, "Meters for Regist of Water." 5. Mr. A. A. Langley, " of Dredging."
Linnean, Burlington-house, W., 8 p.m. Balfour, "New Genera of Plants fr Mr. Edgar A. Smith, "The Fresh Australia." 3. Mr. B. Daydon Jac *Hibiscus palustris* (Linn.) and certair 4. Dr. W. A. Herdman, "Individual Branchial Sac of Simple Ascidians."
Chemical, Burlington-house, W., 8 p.m Brown, "Fractional Distillation" (I W. E. Adeney, "The Estimation of by Means of Potassic Permanganate. Dixon, "The Oxidation of Sulphurou
Royal Historical, 22, Albemarle-street, W Frederick G. Fleay, "History of The from their first opening in 1576 to thei 2. Mr. J. Baker Green, "The Analog and Christian Baptism in the Apostoli
Numismatic, 4, St. Martin's-place, W.,
Civil and Mechanical Engineers, 7, Westn S.W., 7 p.m. Mr. J. H. Maughan, "I Lincolnshire."

Friday, April 22nd...Mechanical Engineers, 2 street, S.W., 7½ p.m. Reading of pape continued.
Quekett Microscopical Club, Universit 8 p.m. Mr. T. Charters White (I Histology of the Gustatory Organs Tongue."
Folk-Lore, 22, Albemarle-street, W., 8 Clarke, "The Relation of English I English Language, and the Influe Exercised."
Clinical, 53, Berners-street, W., 8½ p.m.

Saturday, April 23rd...Antiquaries, Burlingt p.m. Annual Meeting.
Royal Botanic, Inner-circle, Regent's-pa

AL OF THE SOCIETY OF ARTS.

No. 1,483. Vol. XXIX.

FRIDAY, APRIL 22, 1881.

ications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

EEDINGS OF THE SOCIETY.

OREIGN AND COLONIAL SECTION.

y, April 5, 1881; John Rae, M.D., F.R.S., air.

per read was—

: THE OLD COLONY AND THE NEW DOMINION.

By E. Hepple Hall, F.S.S., &c.

I.—Historical.

ver estimate may be placed upon the Canada as a field for British settlement, rison with those offered by other portions itish Empire, there can be no question of nount interest which our Home Colony from a historical point of view. Her history is indeed as unique as it is re-. No part of our world-wide colonial has passed through so many or such ages of existence. Nowhere within the the Crown territory have peace and war, d separation, loyalty and rebellion, fol-ch other in such quick succession. In the struggles between Church and State, party and party, between Parliament le, been more bitter, or the great political which they have contributed to hasten re sudden or more sweeping. Nowhere patriotism of the subject, the supremacy ms, or the prestige of our flag been more ried, and nowhere have they been more idicated or more heroically sustained than a. It will be my honour and privilege, paper which I have now to submit, to e varied stages in her history; to note her rom the infant quasi-colony of a foreign the proud position which she now occu-a integral portion of this great empire; to as well as the short time allowed me ait, the more important political changes each succeeding stage has been marked, state, as far as practicable, the results he present current of events is likely to ut.

gin at the beginning, there was little early existence of Canada to indicate ion which she has already acquired; still less was there to foreshadow the greatness to which she is surely yet destined to attain. The hardy and adventurous Norsemen, if they ever really sighted the Canadian shores, which is extremely doubtful, certainly never landed on them. The occupation at least, if not the discovery of the country, was reserved for later times, and for another race of people. The best authenticated discovery and earliest attested history we have of the country now called Canada are associated with the exploits of that brave band of Venetian navigators who shed such lustre on the closing annals of the fifteenth century. Our North American and South African colonies started in the race of empire—rather let us say took up their appointed places in the circling orbit of our civilisation—together.

While Diaz and Vasco de Gama were seeking a new route to India by way of the Cape of Good Hope, the Cabots, father and son, were tracking the stormy Atlantic, and hunting for a north-west passage, in hopes of ultimately reaching the same goal.

In the very same year (1497) in which the Portuguese navigator weathered the Cape of Storms, and sighted the low-lying coast of Natal, his Italian compeer, accompanied by his son Sebastian, leaving their adopted home, Bristol, in the little barque *Mathew*, which the English monarch had given him, caught the first faint glimpse of the iron-bound coast of Newfoundland. It was only a glimpse, a first sight, a *prima vista*, and so Cabot called it. Two years subsequently to Cabot's voyage, Gaspar de Cortereal, a Portuguese adventurer, hoping to accomplish what his predecessor and competitor had failed to find—a north-west passage to India—set sail from Lisbon, and with two ships reached the Labrador coast, which he named "Terra Verde." He entered the Gulf of St. Lawrence; but of further exploration by him we have no authentic trace.

Thus far discovery on the North American coast had resulted wholly from the desire to discover a north-west passage to India. Not only was the island which now bears the name Newfoundland an actual *terra nova*, but the Labrador coast, and Acadia to the south of it, were in the same category of newly discovered or found lands; and thus they stand roughly outlined on the maps of that period.

Period of Settlement.—The first voyage to North America with a view to settlement is that recorded by Mr. Beamish Murdoch, of Baron Lery et de St. Just, in 1518. Six years later, Francis I., of France, aspired to enter the lists with Spain and Portugal for the acquisition of territory and sovereignty in America. Under his direction, Giovanni Verrazano, a Florentine, was despatched (January 17th, 1524) in the ship *Dauphine*, with fifty men, and provisions for eight months. Little came of Verrazano's visit, save the glory of the occasion. Similarly barren of practical result seems to have been the visit of a "learned and wealthy English citizen of Bristol," Master Thomas Thorne by name, who, favoured with the patronage of King Henry VIII., fitted out two ships, and set sail in May, 1527. Entering the Straits of Belle Isle, and through them reaching the Cape Breton and Acadian shores, the ambition of Thorne and his companions, or more likely their provisions,

failed them, and they returned to Bristol in October of the same year.

Thus fitfully and feebly were the attempts to found settlements on the coast of North America carried on, until the close of the first quarter of the sixteenth century. England's flag of discovery had been thus far wholly in the hands of foreigners; and he would have been a bold man who would then have predicted that England would so soon become the first maritime nation in the world. A floating population, consisting of a few hundred hardy, but humble, Norman and Breton fishermen, roughly subsisting on their frail barques and brigs, anchored on the open Newfoundland banks for seven months in the year, scudding before a stiff nor'-wester, or sheltered between the headlands on some part of the Acadian coast, formed the only appearance of what could be called a settlement or colony. It is not until we come to the French exploration and occupation, that we reach what may fairly and distinctively be called the first period in the history of Canada. This period opened with the voyage and landing of Jaques Cartier, in 1534.

French Occupation.—During Cartier's first visit little was accomplished in the way of actual settlement. Capture and conquest, or conversion, not colonisation, have ever marked the policy of the French in the New World. Cartier seems to have contented himself with anchoring his little fleet off the ancient Stadacona, at the confluence of the St. Charles and St. Lawrence rivers, and of afterwards navigating the river as far as Hochelaga, where he made the acquaintance of the Huron-Iroquois tribe of Indians, and of their king or *Agouhanna.* Cartier's next visit was made in 1541, in company with Francis de la Roche, Sieur de Roberval, whom the French monarch had created Lieutenant-General and Viceroy of his newly-acquired possessions. This was intended as a colonising expedition, the first of any magnitude of which we have any record. But, like that undertaken by Baron Lery in 1518, and, indeed, like most French colonising schemes, it was a failure.

The first actual settlement by Europeans within the territory of the present Dominion of Canada was made in 1605, by De Monts, at Port Royal, now Annapolis, in the province of Nova Scotia. This followed immediately on the formation of the "Company of New France," under patent from Henry IV., for "inhabiting Acadia, Canada, and other places in New France." Events now followed more rapidly. On July 3, 1608, Samuel de Champlain reached the bold headland at the confluence of the St. Lawrence and the St. Charles rivers, the spot where his brave countryman, Cartier, had wintered three-quarters of a century before, and founded the City of Quebec, and where fifteen years later he built Fort St. Louis. From this time till 1629, French exploration and colonisation in Canada was carried on mainly, if not wholly, by the priests. Bands of missionaries penetrated the country in all directions, zealously endeavouring to convert the Indians to the Christian faith. From Quebec, as a starting point, the missionary lines of the "Society of Jesus" radiated in all directions through every inhabited region, from the Laurentian Valley to the Hudson's Bay territory, through the region of the great lakes, and down the valley of the Mississipi. Scantily equipped, with a breviary round the neck and a crucifi[x] the fearless priest set forth, the [...] commerce, and the *avant-courier* of [...] Christianity and commerce went han[d] through Canada in 1630—1670, just as Central Africa to-day, the merchant by the missionary. Conspicuous among [...] M. Joliet and Pères Hennepin, Marque[tte] and Dablon. Lasalle, setting forth [...] Frontenac, had pursued his way to th[e] extremity of Lake Michigan, the si[te] Dearborn and of Chicago in later day[s] reached October 18, 1678. Four year[s] same intrepid adventurer took posses[sion] Mississipi Valley in the name of the Fr[...] and claimed it as part of New France.

In 1670, Charles II. granted to Pri[nce] and his company of adventurers, sinc[e] the Hudson's Bay Company, rights and [...] which have worked a mighty revolu[tion] future of the whole North-West.

Consolidation of British Power.—Alt[...] actual and sovereign dominion of [...] Canada ceased with the famous passa[ge] on the heights of Abraham in 1759, f[...] the defeat of Montcalm, and the capi[...] Montreal in 1760, French influence co[...] be felt in various ways. After the [...] Quebec, the country was placed unde[r] rule. The French Canadians were guar[...] free exercise of their religion, and th[...] continued to enjoy their accustomed [...] privileges. "La Nation Canadienne," th[...] politically, was yet socially and ecclesi[...] vigorous and active as ever. The defini[...] between England, France, and Spain, [...] left England constitutionally stronger, [...] only a prelude to further disturbanc[e] torially, all that was left of "La Nouvell[e] were the little rock-bound and fog-cap[...] of St. Pierre and Miquelon—a somewha[...] cant outcome from so ambitious a des[...] conquest, conversion, and colonisation [...] continent. In 1775, the Quebec Act w[...] and in the fatal concessions to the French [...] contained in this Act is to be found [...] of that anti-British feeling which, eng[...] the powers so conferred, has been perp[...] some degree, to this day. The Frenc[h] law was, however, superseded by th[e] criminal law.

During the years 1784-85, the maritim[e] of Nova Scotia and New Brunswick wer[e] under special constitutional charters, the [...] lature of New Brunswick meeting at [...] now Fredericton, during the latter y[...] year (1791) was marked by the pass[...] Constitutional Act, under which rep[...] government was secured to the peo[...] slow, but steady development of the p[...] responsible government in Canada un[...] Sydenham, Metcalfe, Elgin, Monck, a[...] and the unswerving devotedness of Lo[...] to these principles, serve to make this [...] most interesting epochs of Canadian hist[...] we must pass on yet more rapidly to th[...] the historical portion of my paper.

We now come to the period of conf[...] On October 10, 1864, the Government [...] met the delegates of Nova Scotia, New B[...]

ince Edward Island, at Quebec, to consider eral scheme of confederation. This was . as the "Quebec Scheme." It was the ing of the end—the definitive first step to itish North America Act, the Act of Union, ıal Act and law, under and by virtue of the Dominion of Canada exists to-day. leration was the necessary outcome and of the partial and unjust basis of representa-hich had so long existed in the country. ;hstanding its intrinsic excellence, its advan-were not immediately recognised. One by e links in the lengthening chain of federal were welded together. First, Nova Scotia, 'ew Brunswick, and finally Prince Edward joined hands, These several events ex-. over a period of nearly three years more. not until July 1, 1867, that her Majesty's mation declaring the Dominion of Canada omplished constitutional fact was legally ised. "Dominion Day" is now kept as a moration holiday throughout the country. 870, the ægis of the Dominion Government isely extended over the vast extent of coun-tuate between the western boundary of o and the Rocky Mountains, then known as t's Land, and since as Manitoba, the district watin and North-West Territories. In 1871, ı Columbia joined the Confederation, and 3, Prince Edward Island was added to the Newfoundland, and its dependency, Labra-f all the Imperial possessions on the vast American Continent, now alone remains a colony.

e Confederation,—The British North America s just stated, came into operation on July 1, From that date Canada entered upon the nd—viewed prospectively—most important its history.

l Monck in opening the first Dominion Par-t at Ottawa, November 8, of that year, gave ıce to the following memorable words:—"I tulate you on the legislative sanction which en given by the Imperial Parliament to the Union, under the provisions of which we w assembled, and which has laid the founda-f a new nationality that I trust and believe e long, extend its bounds from the Atlantic Pacific Ocean." The Province of Manitoba lmitted into the Dominion May 12, 1870, e Act creating the District of Keewatin nto force shortly after.

II.—Geographical.

Dominion of Canada as now constituted—y the Federal Union of 1840, then by the leration Act of 1867, and subsequently by tension of 1870-71 and 1873—embraces principal territorial divisions or provinces, aving a Government and Parliament of its It also includes the North-West Territories, tin District, and the islands of the Arctic and Hudson's Bay, which are politically, as s geographically, annexed to them. It s east and west, from the 51st to the meridian, and occupies a superficial area o one-fifteenth of the land surface of the rather more than the United States, and less than the whole of Europe. In the of population they rank as follows:—

Area and Population of the Dominion of Canada.

Province.	Square Miles.	Population in 1871.
Ontario	109,480	1,620,851
Quebec	193,355	1,191,516
New Brunswick	27,322	285,594
Nova Scotia	21,731	387,800
Prince Edward Island	2,183	94,021
Manitoba	120,000	12,228
British Columbia, including Vancouver and other Islands	390,344	10,586
North-West Territory	1,898,000	No returns. —
Keewatin District	309,077	—
Islands in the Arctic Ocean	311,700	—
Islands in Hudson's Bay	23,400	—
	3,406,542	3,602,596

The population, according to the Census returns (1881), already made, but not officially announced, is estimated at 4½ millions.

It is with the comparatively narrow strip of settled country bordering on the Atlantic coast, extending through the St. Lawrence and Saskatchewan valleys on and near the proposed route of the Canadian Pacific Railway to the Rocky Mountains and Pacific Ocean—the fertile or food-producing belt—that I propose to deal in this paper.

As illustrating the composite character of the Canadian people, the following table, showing the nationalities of the four old provinces, according to the census enumeration of 1871, is of interest:—

	Ontario.	Quebec.	New Brunswick.	Nova Scotia.
African	13,435	148	1,701	6,212
Dutch	19,992	798	6,004	2,868
English	439,429	69,822	83,598	113,520
French	75,383	929,817	44,907	32,833
German	158,608	7,963	4,478	31,942
Greek	7	7	1	24
Half-breed	2	—	—	—
Hindoo	8	—	—	3
Indian	12,978	6,988	1,403	1,666
Irish	559,442	123,478	100,643	62,851
Italian	304	539	40	152
Jewish	48	74	3	—
Russian, Polish	392	186	1	28
Scandinavian	686	454	200	283
Scotch	328,889	49,458	40,858	130,741
Spanish, Portuguese	213	142	223	251
Swiss	950	173	64	1,775
Welsh	5,282	283	1,096	1,112
Various other origins	295	32	1	13
Not given	4,508	1,154	373	1,526
Totals	1,620,851	1,191,516	285,594	387,800

The Indians belonging to 36 tribes, number a little over 100,000. They form the relict of the four once numerous and powerful families or races of—1. The Esquimaux or Muok; 2. The Déné-Dindgè; 3. The Algonquin; 4. Huron-Iroquois. They are scattered all over the North-West Territories and British Columbia, and constitute a large proportion of what may be called the "landed gentry and freeholders of this vast and promising region."

In the composition of her exisiting population, Canada is then still peculiarly favoured. Commencing as a French colony, Quebec has over a million of the descendants of the foremost nation

of the Latin race—a people distinguished, like their ancestors, for industry and thrift, combined with a natural courtesy and *bonhommie* which endear them to all. If the French Canadian is not, perhaps, quite on a par with his Anglo-Saxon brother in enterprise, he is certainly more than his equal in those amenities which beautify life, and cast a charm over even the hardships of the backwoods; while in devotion to his country, and loyalty to the sovereign under whom his condition has risen from serfdom to freedom, none can excel him.

Population.—The population of Old Canada (Quebec and Ontario), exclusive of Indians, in 1774, was 166,256. In 1806, the population of British North America, which included Newfoundland, had only reached 476,000. Since that time, more particularly since confederation, the growth of population has been very rapid. During the latter period the figures show a relatively greater increase than do the United States. Thus:—

	Inhabitants.	Increase.
1806	476,000	—
1825	581,920	
1831	1,069,000	24,000 per annum.
1851	2,482,000	70,000 ,,
1861	3,090,561	
1871	3,833,000	70,000 ,,
1881	4,500,000	67,000 ,,

If the present rate of increase, which is shown to be equal to 1·25 per cent., or 12·5 per 1,000 during the last ten years, is maintained during the next two decades, and it is more likely to advance than otherwise, the population, at the close of the present century, will reach, in round numbers, ten millions. According to the census of 1871, more than four-fifths of the population are native-born.

This rapid growth in population is largely owing to the uninterrupted influx of British immigration. Between 1850 and 1878, a period of twenty-eight years, 684,542 strangers settled in Canada, an average of rather more than 25,000 per annum.

Year.	Settled in Canada.	Year.	Settled in Canada.
1851	25,515	1867	14,666
1852	20,943	1868	12,765
1853	32,295	1869	18,630
1854	38,800	1870	24,706
1855	23,000	1871	27,773
1856	24,816	1872	36,578
1857	33,663	1873	50,050
1858	12,340	1874	39,373
1859	6,300	1875	27,382
1860	7,827	1876	25,633
1861	12,486	1877	27,076
1862	28,798	1878	29,807
1863	26,118	1879	30,717
1864	21,738	1880	35,425
1865	19,413		
1866	10,081	Total..	750,864

The forthcoming census returns will furnish us with such vital statistics as will enable us to estimate the precise rate of natural increase in the population of Canada, and these I hope shortly to communicate for a future number of the Society's *Journal*. It is slightly lower than the English rate, and not more than half that of Australia and New Zealand. It will be found, on close investigation, to be not far from 1·10 per cent., or 12 per 1,000. The settlement of the back country, rapid as that has been, has not thus far kept pace with the flow of population to the cities and towns.

The following list embraces the chief cities, with their population:—

	1871	1881 (Estimated.)
Montreal	117,225	160,000
Quebec	59,699	75,000
Toronto	58,092	80,000
Halifax, Nova Scotia	29,582	—
St. John, New Brunswick	28,805	—
Hamilton	27,716	—
Ottawa (Capital)	21,545	—
London	15,826	—
Kingston	12,407	—
Winnipeg	3,000	12,000
Three Rivers	7,570	—
Charlotte Town, Prince Edward's Island	7,500	—
Fredericton	6,006	—
Victoria	4,540	—
St. Hyacinthe	3,746	—

It is shown by the Board of Trade returns that, since 1815, no less than 7,000,000 have emigrated from these shores, of whom only 2,550,000 have gone to the Colonies, while 4,400,000 have for ever abandoned their allegiance and become citizens of a foreign country. I think (with Sir Alexander Galt) that this is a most deplorable fact, and becomes the worse if we regard them in the light of helpers of their former fellow-subjects at home.

The chief factor in this continued exodus from our shores is to be found in the over-population of the United Kingdom, and in the absolute necessity of providing againt the evils—ever increasing, and daily becoming more threatening—which are traceable to this cause. Emigration, continuous, progressive, and systematic, is the only certain remedy and forms, at the same time, the only boon Canada asks from the mother country.

We have, since 1815, a total removal of population from the British Islands to other countries of the enormous number of seven millions, distributed very nearly in the following manner:—

United States	4,400,000
British North America	1,350,000
Australia	1,000,000
Elsewhere	50,000
	7,000,000

The striking and significant fact unfolded by these figures is, that up to 1841, and, indeed, until 1848, the movement of British population to British North America was actually in excess of that to the United States. After 1841, two causes operated to turn the flow of emigration more largely to the United States; the first was the condition of Ireland up to and succeeding the famine, the other was the passage of the Homestead Law and the contemporaneous opening up of the vast prairie States of the Union, which began to attract general notice after 1840.

The latter causes were, I think, much the more important, and to them I believe the United States are indebted for the rapid strides they have made in population and wealth, and the great attraction they have offered to the emigrating classes, not only of the United Kingdom, but also of Germany and of Scandinavia.

production.—I have already stated the emi-ion to have reached seven millions, of which at t four millions have left the United Kingdom e 1852. It will probably interest you to know , notwithstanding this immense overflow, the oductive powers of our population have more ı supplied the gap. In 1853, the population of ıt Britain and Ireland was 27,542,588; in 1879, 56,113, showing an increase of 6,613,525.

onsidering this enormous increase of the resi- ; population, coincidently with an emigration 000,000 since 1852, it will scarcely, I think, be uted that no more important question can ıanenly occupy attention here, than the best e of systematising and directing the outflow of people. Had these four millions remained at e, it is probable that the position of affairs here ld have been much more critical, and might e been even seriously dangerous. As an illus-ion of this, I will refer to the state of Ireland, onnected with emigration.

From 1861 to 1870	it averaged	81,858	
1871 ,, 1875	,,	65,893	
1876 ,, 1879	,,	29,898	

; does not appear an unwarranted deduction to me that the comparative cessation of emi-ion, noticeable during the four years 1876-79, intensified the evils in that country, which ence clearly shows, on the west coast at least, be traceable to over-crowding. When we nly see that congestion of population has fol-ed upon a decline or partial stoppage of gration, it appears to me that the simplest and t speedy cure will in many districts be found he systematic encouragement of voluntary gration. I use the term "voluntary" advisedly; the only principle upon which any Govern-t could act. If experience in the treatment of great subject has taught us anything, it has ht us that the courses of emigration cannot be lated by political considerations; and that isation is, after all, not so much a matter tate policy and Imperial legislation as of ral law and rightful selection. Mr. Parnell oses to make the occupants of the Irish soil wners, and Mr. Bright proposes the purchase million acres of waste land in Ireland, its ovement and drainage, and the division of it ıgst 40,000 families, on farms of twenty-five s a piece, a work which he said would be cheap 10,000,000. Our contention is that it would ery much cheaper and easier, and therefore r, to spend this money, if money is to be spent, ıcouraging emigration to a land where owner-in the soil is easy and its returns sure. Partner-in emigration, which most fitly formed the ect of Mr. McCullagh Torrens's, M.P., recent ess before the Royal Colonial Institute, in order ecommend itself to the intelligence and con-ıce of the nation, must work equally for the fit of the United Kingdom, the Colonies, and emigrant—a fact which has been too little ıe in mind in recent discussions on the emigra-question.

at there is still another light in which this ssing and all important theme of migration t be viewed. It is that of trade relations be-n the mother country and the nearest of her nies. It will be seen by the Board of Trade returns that, on an average of the last three years, notwithstanding the recovery of prosperity was more early, every person, and, therefore, every emigrant in the United States, has consumed only 8s. 4d. worth of British manufactures, while in Canada he has consumed 32s. worth; it is, there-fore, in the interest of British labour at home, in the proportion of 32 to 8, that emigration should go to Canada rather than to the United States.

I will now, with the aid of the map, do my best to pourtray to you some idea of the magnitude and value of the trust that has been assumed by our trans-Atlantic fellow subjects in undertaking the colonisation and government of the northern half of the great North American continent. Here you have presented a domain nearly as large as all Europe, stretching from the Atlantic to the Pacific Ocean, its southern boundary resting in the latitude of the South of France, and its northern line is washed by the waters of the Arctic Ocean. Possessed of the finest forests in the world, most prolific and profitable fisheries, watered by the most extensive system of fresh-water lakes and rivers, enriched with well-nigh every known variety of mineral, including abundant supplies of coal and iron, and now proved beyond any question to contain the largest area of fertile prairie and bread-stuff producing soil in the world—destined, at no very distant day, to become the granary of Great Britain, and the happy home of millions of our countrymen and women.

The Dominion of Canada is naturally divided into three great divisions—the Atlantic, or Eastern; the Central, or Prairie; and the Pacific, or Western.

The Atlantic division is that which comprehends the older settled provinces of Nova Scotia, Prince Edward Island, New Brunswick, Quebec, and Ontario. It contains almost the entire present population of the Dominion—about four millions, and is the only part of the British possessions in North America to which emigration has been hitherto directed. It may be described as the woodland, or forest section of Canada, and stretches from the Atlantic to the head waters of the great River St. Lawrence, west of Lake Superior.

The Central, or prairie division, containing the new province of Manitoba, and the adjoining north-west territories, extends from the densely wooded Atlantic region to the Rocky Mountains. Commencing with the valley of the Red River, the prairie extends westward over a gently undulating country, clothed with the most luxuriant grasses and beautiful flora, for a distance of a thousand miles to the base of the Rocky Mountains, varying in width of from four hundred to six hundred miles. This magnificent district, watered and rendered accessible in its eastern section by the great Winnipeg and Manitoba lakes, is in its central and western portion traversed by the mighty River Saskatchewan, with fifteen hundred miles of steamboat navigation, and ferti-lised by many beautiful tributaries issuing from the recesses of the mountains. With some com-paratively insignificant exceptions, the prairie division of the Dominion contains probably the largest continuous tract of country in the world adapted to the growth of wheat and other cereals, and peculiarly fitted also for cattle-raising, espe-cially on the western plateau, where cool and

abundant water is combined with an exceptionally moderate climate. Settlement in this section is now exceedingly active, and likely to be continuous. During ten months of 1880 (January to October), the total immigration returns were 17,981.

The Pacific section, known as British Columbia, comprehends the volcanic region west of the Rocky Mountains to the Pacific Ocean, with the magnificent archipelago of islands of which Vancouver and Queen Charlotte's groups are the most conspicuous. Possessing a climate much more temperate than that of Canada proper, British Columbia has an immense extent of land fitted for agriculture, while the mountain ranges which traverse the country are replete with minerals of every variety, and are, it is thought by some, quite as rich as the similar districts of California and New Mexico. Gold to the value of eight millions sterling has already been extracted from the gravel-washing alone, without the introduction of machinery. Vancouver's Island has, so far as known, exclusive monopoly of the coal supply of the entire Pacific coast, from Behring's Straits to Cape Horn; her coal-fields are inexhaustible in extent, and excellent in quality, and, in the future, must make this island the emporium of the China and Indian trade, while its importance in connection with the naval supremacy of England in the Pacific Ocean can scarcely be exaggerated.

Physical Geography.—The coasts of the Dominion are everywhere extensively indented. The most remarkable of these indentations form the extensive inland seas known as Hudson's Bay, the Gulf of St. Lawrence, and the Gulf of Georgia. The Hudson's Bay, the Mediterranean Sea of Canada, merits a separate paper, and will, I trust, ere long, find a delineator worthy of its growing importance. It is thus described by Dr. Bell, who has spent five years in exploring its waters and shores:—

"Instead of being, as is usually supposed, a part of the Arctic regions, its nearest shore is more southerly than London, and its farthest still remains within the north temperate zone. On the north-east coast there is little snow in winter, and little rain in summer. The tributaries of the bay are the Nelson, which discharges the waters of Lake Winnipeg; the Winnipeg, about the size of the Ottawa; the Saskatchewan, 900 miles long, pouring in from the west; and the Red River, coming 500 miles from the south. All the central part of North America, from Labrador to the Rocky Mountains, drains into Hudson Bay. The largest tributary is the Nelson, about four times the size of the Ottawa, at the capital; then comes the Churchill, the Big River, and the Albany. On the west side of the bay, the southerly winds are the coldest that blow in the winter, and there is less snow and less intense cold in the vicinity of York Factory and Fort Churchill than in more southerly regions. During winter, the temperature improves as one goes from Minnesota northward through Manitoba, and down the valleys to Hudson Bay, and bathing is found agreeable in July, August, and September. On the southern and western shore, unlimited supplies of red and white pine, spruce, white birch, balsam, poplar, aspen, and tamarac are found."

Owing to her remarkable physical configuration and extensive watershed, Canada possesses the largest lake and river system in the world. The volume and surface area of her lakes and rivers are equally remarkable. The hydrographical basin of the St. Lawrence, with the great lakes Superior, Huron, Michigan, St. Clair, Erie, and alone occupy 330,000 square miles. They largest and purest continuous system of fr in the world, and impart to the Dominic fectly unique hydrographical character.

The lake system of Ontario and the c prairie region embraces, among many bodies of water, Great Slave, Great B Athabasca Lakes, Winnipeg, Manitoba pegoosis, and Lake of the Woods, Simcoe, and Nipissing.

Next to the St. Lawrence, the most i rivers of the Dominion are the Saska Mackenzie, Peace, Nelson, Athabasca, Ass Albany, Churchill, and Winnipeg, all fl the vast North-West territory; the C Fraser, and Thompson in British Colum Ottawa, which forms the boundary Ontario and Quebec provinces, and i tributaries the Gatineau, Madawaska, I and Matawan; the Saguenay, Richel Maurice, and Chaudière, in Quebec; the S Miramichi, Restigouche, and Petitcodiac, Brunswick; the Shubenacadie, St. Ma Have, Avon, and Annapolis, in Nova Scot the York and Hillsborough rivers in Edward Island. Only the better known rivers have been navigated to any cons extent with steam craft.

Thus Canada possesses a continuous w from the Atlantic to the head of Lake S and thence, with a few unimportant port "carrys," on to Vancouver's Island, a natu way of trade and travel, unequalled for ex grandeur in the world, and the best, bec cheapest and healthiest emigrant route a American continent.

"Climate," says Professor Ansted, admirable compendium of "Physical Geog "is a very complex matter, and one depe a great variety of conditions." These extent affect and depend on each other, may ultimately be traced to certain gener connected with physical geography. The r logical service of Canada forms a branc General Department of Marine and Fishe is most admirably superintended. The Office and Magnetic Observatory are at and thence daily weather warnings are sent than 600 places throughout the Dominion all speculation on that delightfully exciti ject of ordinary English table-talk is sp Canadians, and the time turned to more p account. It is a matter for regret that the mind, though certainly less abused than i in regard to the climate of Canada, is still and unjustly prejudiced in regard to it among the very healthiest climates in the as is proved by the bills of mortality. It influences the formation of the robust cons and sturdy determined character for wh Canadians are conspicuous. Climate, a difficulties attendant on overcoming the i the wilderness, naturally impart great ene courage to such a population, and brin those wonderful results of successful which excite the envy and admiration world.

Resources and Products.—Agriculture f chief and abiding interest and industry

ion. That farming pays in Canada is suffi- proved by the fact that more persons are d in it than in any other branch of industry. , nearly one-half of the whole population, last census, were then engaged in agri- ; and this proportion has, I think, been fairly ed during the past ten years. By way of ting the rapidly progressive character of nadian farming industry, it is sufficient to he yield and export of the staple crops at eriods during the past half century. In ne average export of wheat did not exceed O bushels. In 1850, it had increased to OOO, and, in 1880, the grain and green crops ed to 125,000,000.

ng the last 20 years the wheat production n greatly stimulated, and Canada now pro- 0,000,000 bushels, and a total of 170,000,000 ls of all crops, or about 42¾ bushels per itant. When the wheat fields of the new h-West are fairly under cultivation, say before lose of the present century, Canada will have eat surplus for export of 100,000,000 bushels— cient to supply the deficit in the present wheat umption of the United Kingdom.

storal farming, which includes stock-raising dairy farming—next to agriculture—is the t important industry of Canada, both soil and ate being favourable for its prosecution. ses, it is well known, thrive best in the region mmer rains and moderate summer tempera- , *e.g.*, in the middle and higher parts of the erate zone. The high quality of Canadian produce is now everywhere acknowledged. io and the eastern townships of Quebec offer, ps, the best openings for those wishing to e in this branch of business. Manitoba and orth-West Territories will, however, offer sed advantages as soon as railway communi- . is established through them. The quality wool, mutton, and beef raised on the grasses North-West prairies is even finer than that ced in the eastern provinces and townships. e and butter, to the value of 8,500,000 dollars, nnually exported. The production of the r article advanced from 20,000,000 lbs. in to 40,000,000 in 1878. Beetroot is now pro- . in Ontario, and a company has just been d for its further growth and manufacture ugar. By recent Act of the Dominion Parlia- this branch of industry is exempt from tax ght years. The foot-and-mouth disease, and epidemics generally, are unknown through- ne Dominion.

nada, having an extremely diversified geo- al formation, is rich in minerals. In the entian (or St. Lawrence) region, the mineral sits are especially extensive.

ough every way subordinate to her fertile , her grand forests, and prolific fisheries, as a e of wealth, her mineral deposits must, as al and labour make their influence felt in the try, attract increased attention and develop- .

single province except, perhaps, Prince ard Island, is without mineral deposits. Nova a and British Columbia are rich in coal and the total yield of coal in these provinces for being upwards of 900,000 tons. The follow- res have been worked:—Gold, silver, copper, lead (galena), iron (magnetic), hematite (chromic and titanic), coal (lignite and albertite), apatite (phosphate of lime), graphite, mica, barytes, asbestos, slate, gypsum, petroleum, rock salt, antimony, iron pyrites, and manganese. The total exports for 1879 amounted to 4,000,000 dollars, or to rather more than three-fourths of a million sterling.

These minerals are not confined to any one province, but are found deposited in one form or another, and in greater of lesser quantities, in every part of the country, from the Atlantic to the Pacific. We can only mention a few of the more valuable mining districts and their chief productions.

Gold has been found and successfully worked, though in a small way, in British Columbia, Nova Scotia, Quebec, and in the Marmora and Medoc districts of Ontario. The method thus far pursued has been that known as "quartz" mining. The average earnings of miners at the present time is estimated at 700 dols. a year.

Silver is known to exist in several sections of the Dominion. By far the richest deposits thus far found have been on the north shores of Lake Superior, south of the Thunder Bay section of the proposed Canadian Pacific railway. Silver Islet has been pronounced one of the most extensive and valuable silver mining properties on the Continent. Thus far silver mining has been the merest surface scratching.

Veins of argentiferous *galena* are found in almost every section of Quebec south of the St. Lawrence.

Iron and Coal.—Iron exists everywhere throughout the Laurentian ranges. Nova Scotia takes precedence of all the other provinces in the extent and value of her coal and iron mines. There are some twenty mines in operation on the mainland and the island of Cape Breton, and they yield, on an average, one million tons annually. New Brunswick ranks next. Ontario, Madoc, and Quebec exhibit an annually increasing out-put of iron, but the difficulty of obtaining coal for smelting purposes, and the substitution, as far as practicable, of charcoal, is found to operate unfavourably to its extension in that direction. The coal mines of Vancouver (British Columbia), give employment to a large amount of capital and labour. Anthracite coal of fair quality is found on Queen Charlotte's Island. The "lignite" formations at "Roche Percé," in the Souris River Valley, in the vicinity of the 49th parallel, are now under survey by Professor Selwyn, whose report may shortly be expected.

Oil.—Petroleum, or coal oil, abounds in South-West Ontario, being largely distributed over the western peninsula.

Copper.—Canadian copper is noted for its purity. Mines have been opened along the shores of Lakes Huron and Superior. The "Bruce" mines of Lake Huron are said to yield copper ore to the value of £50,000 annually.

Salt wells and springs are abundant in New Brunswick.

Peat abounds in Quebec, in the island of Anticosti, and in come parts of Ontario.

British North America contains the most extensive and most valuable forests of timber in the known world. Fully one-half its entire surface is still covered with timber. The value of the timber

annually shipped may be roundly stated at 20,000,000 dols. Only the square timber is exported; the logs are manufactured into lumber at home. Forest conservancy and tree culture are, I am glad to be able to report, at last receiving deserved attention. The average Canadian farmer, like his compeer of the Republic, has hitherto displayed little taste in the management of his farm. He was wont to regard every tree as his enemy, and to ruthlessly hew and hack down every shrub and tree within reach of his stalwart arm. If he settled in the bush, the first thing he did was to clear a space round his house, and then he and his grandchildren went on clearing and clearing, until at last his home stood alone. In certain parts of the United States the law wisely offers a premium for trees grown, and the result is that barren wastes have become living forests, and ghastly homesteads have been surrounded by stately evergreens. Canadians must do the same, if they would maintain the hold which they have so long enjoyed in the lumber markets and shipbuilding yards of the world.

Fisheries rank third in importance among the sources of natural productions in Canada. "From Lake Ontario down to the straits of Belle Isle, a distance of nearly 2,000 miles, there is hardly a mile of coast line," says Rowan, in his charming book, "The Sportsman in Canada," "without a river or stream which affords fair angling." The sea-coast fisheries of Nova Scotia, New Brunswick, and British Columbia produce a handsome revenue to the country, and are capable of almost limitless extension. Compared with last year their produce is valued at about half a million more. The following tables, extending over a series of years, establish the fact that this improvement is not casual or spasmodic, but gradual and permanent. The value of the fish product for 1879 was 13,529,255 dollars, of which one-half was exported. This was an increase of 313,576 dollars over the yield of 1878; for 1877 it was 12,029,957 dollars; for 1876, 11,147,590 dollars. The production in each province of the Dominion was as follows:—

	1876.	1877.	1878.	1879.
	Dols.	Dols.	Dols.	Dols.
Novia Scotia	6,029,050	5,527,858	6,131,600	5,752,936
New Brunswick	1,953,388	2,133,237	2,305,791	2,554,722
Quebec	2,097,667	2,560,147	2,664,055	2,820,396
P. E. Island (840,344)	494,967	763,036	348,122	1,402,301
Ontario	437,229	438,223	—	367,183
Manitoba	30,590	24,023	—	—
British Columbia	104,697	583,432	—	—

The values of the different principal fisheries or products for 1877, were:—

	Dols.
Codfish	3,561,199
Herrings	1,522,091
Mackerel	1,667,815
Haddock	475,723
Salmon	855,687
Lobsters	1,213,085
Fish oils: cod, seal, whale, porpoise, dogfish, &c.	524,627

The number of fishery licenses issued in 1880 was 4,334, and it is estimated that fully 250,000 people, or one-sixteenth of the entire population, support themselves on this industry.

III.—Public Works.

The public works of Canada are on a s mensurate with her own grand propor may in truth be said that they compar ably with those of any other country in t Their valuation, at the close of 1880, was 42 dols., equivalent roundly to £80,000,00 more than twice greater than the Domin Of these works we can only now refer to ways and canals, believing them to be important. The former, which already forty-six main, or trunk, and branch rapidly increasing, both in number a Among the best known are the Gran Great Western, Inter-Colonial, Canada S Prince Edward Island, Northern and Central roads. The last-named railway junction with the extension of the presen railway system northward, from Grave Calender station, will form a most impo in the through line, which will ultimatel from Halifax and Quebec to Vancouve Trains are now running westward of Deux and it is announced that the entire line t East Bay (Lake Nipissing) will be c by December next. The mileage of t railway system in operation and under tion at the close of 1880 was 7,906, a v factory exhibit for a population of less t and a-half millions. Of the character o these lines it is needless here to speak, say that as regards both construction a ment they compare most favourably wit and most popular of the United States r

The Canadian Pacific Railway—the porating, which has just passed the Parliament—is now in the hands of a str cate of English and Canadian capitalist confidently believed that this great und the most extensive, and judged by possib the most important public work yet und colonial soil—will be pushed with the and vigour so characteristic of our Tran brethren. Its length, when complete 2,600 miles. Of this, as most of you 264 miles, or 10 per cent., are now un 600 more, on the Superior and central se promised before December next, and w assurance of those who have the best ri expression of opinion on the subject, that close of 1885, communication by water a tween this dear mother-land of ours and th verge of the "Big Farm," which futur tions of her sons and daughters are to p make productive, will be complete and i order. The track on certain sections of the prairie country, has been laid at the of 13,500 dollars, or less than £3,000 per practical engineers among us this fact wi illustrate the favourable conditions un the whole line between Lake Superior Rocky Mountains will be constructed. T terms of the agreement between the Government and the Canadian Pacific Rail pany have not yet been officially annou would this be the place to discuss the were. Enough, however, is known to sa the least hopeful among us that this m enterprise will, ere long, be among the suc

this marvellous nineteenth century, t both Government and company are ngratulated on the bargain they have r favouring circumstances, been able . What is so unmistakably for the ood of the whole nation cannot, in the , result in pecuniary loss to anybody. l the absurd fears which have begun in home quarters in regard to the creation antic railway and land monopoly be tertained. The Dominion Government, be borne in mind, possess an interest in of the North-West, far exceeding that to the railway company created by them. re between 100 and 150 millions of acres se of over and above the grant of 25 for the construction of the railway. uable measure will tend to check any on of power or improper discrimination ege at the hands of railway companies speculators. Moreover, the company d by the toll clause of the Railway Consolidation Act, cl. 9, sec. 17, nacts that "No tolls shall be levied until approved of by the Governor cil, nor until after two weekly publica- the Canada *Gazette* of the bye-law esta- such tolls, and of the Order in Council g thereof." It may be remarked in this n, on the authority of the Dominion Minister's last report, that the railway f the country was never before in so pros- condition.

. — The canals of the Dominion cost)0, or about one-tenth the amount in- railways. They need not be more par- described in this paper. They form the to speak, in the ever-lengthening chain of ntinental commerce, and those wishing to re about them will find the whole subject ely treated in the comprehensive "Hand- Canada," just announced for publication s. Silver and Co., of Cornhill, the proof- which have been courteously furnished largely availed of in the preparation of r.

orm enlargement of the whole canal system n progress, which will enable vessels of s to pass from Lakes Superior, Michigan, on, through Lake Erie to Montreal and a sea. When completed, the canals of will practically extend ocean navigation to of Lake Superior, and thus put our kinsmen hbours in a position to compete success- h the Americans in the vast and all but trade of the west and north west. As is ell known among freighters, shippers, and men generally, the real competition rail and water lines, *e.g.*, between the n and Canadian systems, commences at the d of Lake Erie.

elegraph and lighthouse systems of the n fitly supplement the other branches of lic Works Department first referred to. A two ago the Canadian Government became the great importance of a telegraphic connecting the islands, lighthouses, and the Gulf of the St. Lawrence together, for er protection of the fisheries, and the of shipwrecked vessels. Not only has this most humane and prudent scheme been carried out, but a telegraph line from Red River across the "Fertile Belt" to the Rocky Mountains, and thence to Vancouver, has been completed, while a Bill has been granted for its extension thence by submarine cable to Japan, China, and our Indian possessions.

All the most important colonies and dependencies of Great Britain will, by means of this line, be placed in direct and continuous communication with the parent Government, without passing through any foreign hands whatever. The total cost of the cable is estimated at four millions of dollars, or about £800,000, which sum includes the completion of the Dominion land lines.

Defence.—The defence of Canada is, since con- federation, wholly in the hands of her own sons. The law requires that every able-bodied man may be enrolled in her defence. The active militia force numbers 40,000, and the reserve force 600,000 men. Reporting upon Canada's system and means of defence, Lieut.-Col. Strange, commanding Quebec citadel, says:—"Owing to the peculiar configura- tion of the southern boundary—on which side alone it is open to attack—few vulnerable points exist. The Intercolonial and Grand Trunk systems, sup- plemented by the Dominion Railroad system, generally enable the troops and militia to act upon what are practically interior lines."

The trade of the Dominion has made itself felt only within the last fifty years. The first steamer navigated the St. Lawrence waters as early as 1809, but commerce advanced with slow and measured step for more than twenty years after that date. Since 1829 trade has multiplied fifteen- fold, a rate of increase fourfold greater than that of its population.

For the first time in the history of the Dominion, says a recent writer, we find an excess of exports over imports to the amount of nearly a million and a half dollars. Our trade with Great Britain, in 1880, was about £16,000,000 sterling, an increase of more than two millions and a half sterling over 1879. Our trade with the States decreased by over a million and a half sterling. Our trade with the West Indies and South America amounted to about £1,500,000, an increase over 1879 of £400,000 sterling. Trade with China and Japan shows an increase of £405,000. The export of manufactures. increased by nearly £1,000,000 sterling. In 1879-80 the inward and outward tonnage amounted to 6,786,000 tons against 6,088,558 tons the previous year, an increase of 700,000 tons. Upwards of 113,000 of her hardy sons sail the broad ocean in ships, pulled, masted, and sparred from timber grown in her own grand forests. To sum up this branch of our subject it may be remarked that Canada, with a population of four and a half millions carries on a trade equal in value to that of Great Britain at the beginning of the century, with a population of nearly sixteen millions.

Canada is to-day the fourth maritime power in the world. Her sails are unfurled in every sea, and her hulls are found in every port. At the close of 1880, the register of her shipping included 7,377 vessels, with 1,311,218 tons. Of these, 797 are steam craft, having a capacity of 158,862 tons. The total net value of her shipping is nearly eight millions sterling. Perhaps no readier or safer indication of the growth of Canadian trade can be adduced, than that furnished by the

experience of our common carriers, the great ocean steamship lines. Sixty years ago, the Messrs. Allan commenced sailing ships from Glasgow to Canada, and 28 years ago they built their first steamship, a vessel of 1,500 tons, for the mail service between Liverpool and Canada. Now this has expanded to a fleet of 24 ocean steamships, amounting to over 70,000 tons, while the total tonnage owned by them amounts to very close on 100,000 tons. There are also three other regular steam lines, the "Dominion," "Temperley," and "Beaver," besides occasional cargo steamers which ply between British and Canadian ports. Within the present year, a new steam line, under a Government subsidy, by Canada and Brazil, will open the markets of that vast empire to the varied produce of the Dominion, and it is every way probable that similar relations will shortly be established with France and the Spanish West Indies. Increased steam service is also asked between the maritime provinces and England, for shipment of cattle, &c. Now, a word or two only on a subject of great interest—I may say of principal and interest—the debt of Canada.

Finance, Debt, &c.—The entire debt of Canada on 30th June, 1880, was 199,125,323 dols., equal to £40,000,000, reduced by sinking funds and other assets to 156,942,471 dols., or about £32,000,000, equal to £9 9s. 4d. per head, against £46 per head in New Zealand, and nearly £21 in Victoria. The taxation for the present year, Sir Leonard Tilley assures us, will not exceed 22s. 6d. per head, or less than half the average taxation of the Australian Colonies.

The guarantees by the Imperial Government on Canadian account are thus stated in the Finance Account for 1879-80, March 31:—

For construction of railway from Revire du Loup Q. P to Truro, Nova Scotia	£3,000,000
Purchase of Rupert's Land	300,000
Canadian Pacific Railway and Improvement of Canals	3,000,000
By way of security for these guarantees, amounting to six millions three hundred thousand pounds sterling, there is a sinking fund against the first guarantee of ..	358,600
Against the second	39,800
Against the third........................	86,400
	484,800
	6,300,000
	£5,815,200

There would, therefore, appear to be a balance of rather more than five and three-quarter millions sterling, the payment of which, by Canada, has been guaranteed by the Imperial Exchequer. The interest on this sum is promptly paid by the Dominion, and Mr. Gladstone has, himself, publicly stated in the House of Commons, that not only has the pledge of the Dominion Government never been violated, but that her credit is to-day stronger than ever.

The national policy, according to Sir Leonard Tilley's last budget report, is, on the whole, worthy of the confidence of its founders. He at least entertains no doubt as to the revenue creating power of the present tariff, or of its ability to meet all the requirements of the country.

The deposits in the Dominion Post-offices and Savings'-banks afford a sufficiently goo the general prosperity of the peopl amounted in 1878 to nearly nine millions o in 1879 to nearly ten millions, and in 11,688,356 dollars. On the 31st of Janu present year they were 14,730,594 dolla ing an increase of 5,732,481 dollars—mo million sterling—in the peoples' saving added to bank deposits of twelve million total of 18½ millions of increased deposi the past year.

With these brief and somewhat delivered facts and figures respecting Ca paper must close. The Home Colony is bef such colours as a careful study of her reso needs enable me to present. Her past interest. Her future is full of promise. no need to exaggerate her advantages enforce her claims upon the attention and home-loving people. The silken t pathy which, for more than one hund has bound the mother country to her nearest, and—may I not add—dearest c shortly be strengthened by the iron barr mon material interest, thus linking t of ours with the dominion in stronge social and commercial union, for purpos support and defence. Though we m with the poet what our American cousi weary of repeating—

> "No pent up Utica contracts our powers,
> The whole, the boundless continent is ou

Though we may not, I repeat, say this, and trust that the day is far distant, r never dawn, when our flag shall cease t any portion of our present North Ameri Never may we cease to feel the emotions o and pride which instinctively rise in c we recite the words of our own glo bard:—

> "O'er the glad waters of the dark blue sea
> Our thoughts as boundless and our souls
> Far as the breeze can bear, the billows fo
> Survey our empire and behold our home.

DISCUSSION.

Mr. Lionel Boyle intended to limit his re portion of the immense Dominion of Cana described in the poetical language of L as "the keystone of the mighty arch stretching across the entire continent from to the Pacific Ocean." It was strange th bilities of so fertile a country should have little known in England, but it had separated from the rest of the world by w ways, and, to some extent, also by the the Hudson's Bay Company to encou emigration to one of the best countries furred animals. Every practical man wh it, including Lord Dufferin, had admitte was no finer or more fertile country in the w said of it that the winters were too long an but they were not so long or so severe as th at all events, in the latitude of St. Petersb severity of her winters had not prevented becoming a great nation. Very strange it the 7,000,000 emigrants from this count been referred to, so large a proportion gone to the United States, from an id States offered greater advantages to sett own colony, for that idea was erroneous. be some systematic means devised of induc

that grand country, whether by Government e enterprise. The relationship of England es should be that of a mother to her children; e had had every opportunity of developing eir expense, she had not yet tried her hand em. The total emigration from this coune last 49 years had been 7,782,209, of which r 5,226,000, had gone to the United States, America and Australia had only received ,000,000 each. Surely it was time that was time might arrive when it would be desirwheat we required should come from our own d of from the United States, though war ter was not probable at present, and that could be furnished by Manitoba. Much to promote emigration to our own colony, the United States, by the reading and such papers as they had just heard.

rry, C.B., agreed with the reader of the e urgent necessity of information being liffused amongst all ranks of people at egard to the value and importance, as lds, of our own vast and fertile territories ad, however, of recuperating and recruity transplanting our people to our own were absolutely exhausting ourselves, n, from lack of proper information and and it might be, in certain cases, of of help from Government, drift away to h kindred, nation. While it would be than unfair to attempt to coerce emigray, or to narrow it into any one channel, ur policy so far had been fatally neglectinterests as a nation, and by no means as ose who left us as it might have been. s they had heard should be the means of attention from the public and from the the vast and pressing importance of the were, he believed, God's best gift to us l needed a large, a wise, and more gene. He could not but feel that, to a great use of them now, in the crisis of their l, would depend the continuity of their ld home and flag, and our own true ation. Mr. Hall had touched briefly, but r most pressing and important subject— l defence, of strengthening all essential safety of the whole expanse of British , and might he not add of the empire of England throughout all her dominions. tly, and specially called attention to land, and the Pacific Coast. That leed most valuable, not only from its and their feeding powers for the naval marine, but from its position on the pan, China, and India. Mr. Hall had ouch upon Imperial defence. It was to the Royal Commission now engaged on d meet it in its entirety, and that fuller e given them to do so. Having comment for many years in and throughout ts of British North America, he could the reader of the paper had said as to omposing the defensive force of that o finer men, or hearts more loyal to the and than in the soldiery of Canada could here.

lgeeme pointed out that there seemed to reement among those present as to the he confederation of the mother country es, but some practical means of initiating t this policy had not been alluded to in marks. That policy could only be carried is of mutual interest between the home r Colonial Empire. It was absolutely the present conditions of trade with America, and the physical disabilities under which the Dominion still labours, for us to expect to receive the whole of our American food supply at all seasons, or even, perhaps, at any season of the year, from Canada in preference to the United States. Canada should be treated by us as a part of our own country. The British farmer might be brought some day to regard migration from the mother country to a colony in the same light as he would regard migration from Cornwall to Northumberland, and when once that idea was accepted, emigrants would not be so easily tempted to foreign lands. One danger before us was, that the more valuable Canada becomes (and she was becoming more valuable every decade) the more likely were we to lose her. There was a strong feeling now existing in the United States in favour of the fiscal absorption of Canada. This was well illustrated by a recent article in the *Chicago Tribune*, referring to the policy of Mr. Blaine, and advocating the present time as a good opportunity for "including the whole continent north of Mexico under one system of commercial regulation, whereby one and the same tariff law, the same scale of duties and imports, the same Custom-house rules shall prevail everywhere, alike in the United States and in the Dominion provinces." That was a material danger ahead, involving the probability of a wall of hostile tariffs against us right along the North American seaboard. The panacea for this danger, in his view, was to aim at a Customs union between every portion of the British Empire, as against those parts of the world that would not join us in full and fair commerce.

Mr. Pfoundes said the valuable paper read that evening would, through the medium of the columns of the Society's *Journal*, extend far beyond those who had had the pleasure of hearing it read, and it was to be regretted that lectures, conveying similar information, were not delivered throughout the provinces and in Ireland for the benefit of intending emigrants. With regard to the history of those earlier explorers of North America, the Cabots, he would point out that there existed quite a literature concerning them, which was not open to the ordinary reader. It was erroneously supposed that they were Italians, but, in fact, they had been traders of Bristol for a generation or two. Cabot's maps, charts, and papers were entrusted to a person who had apparently betrayed his trust, for on the death of the great navigator, it was found they had disappeared. Remembering the rivalry that existed between the Spaniards and Portuguese at that period, it might easily be imagined how those documents came to be suppressed by people whose interest it was to do away with them. From searches in the libraries, however, he had satisfied himself that, however scanty the information on the subject might be, some was to be obtained. Having lived for a long period, as boy and man, in the colonies, he had taken interest in many emigration schemes brought forward for the mutual benefit of the colonies, and of emigrants especially from Ireland. But the right sort of emigrants would never be obtained by Imperial schemes. Without venturing into the forbidden region of politics, as a member of the Colonial Institute, he could say that their motto was "a united empire." If that motto were not acted upon, we should lose the colonies, though not from a want of loyalty in the colonists themselves. He had been one of the midshipmen appointed to the first Victorian war vessel, the steam-sloop *Victoria*, and therefore knew something about colonial loyalty. If the Imperial Government could in any way devote public money to assist emigration, it should be done in a way that would not injure the self-respect of the people, but leave to themselves the choice where they would go. Each colony had at present its own emigration agent in England, trying to get as many passengers and much money as possible; and what was wanted was a national emigration agency, where

people of all classes could go and get unbiassed, unprejudiced information, where each particular case would be taken into consideration as to ability, trade, or physical strength, and each person advised to go to the place most suitable for him.

Dr. Mann, having alluded to the practical character of the paper, drew attention to the circumstance that the Canadians appeared to be so generally able to occupy themselves in agriculture, a fact of great importance in considering the character of the colony. Then the aboriginal population was 100,000, instead of 700,000, as in such small territories as the Transvaal, or 360,000, as in Natal. That was an important fact for persons seeking to live by agricultural labour. If once a good system of starting emigrants in their new sphere of life could be organised, there would be no difficulty in filling our colonies with a large and prosperous population. The difficulties of colonisation were enormously increased, by having to deal with native populations ready to work for next to nothing. As the facts stood, in Canada there was a large territory of as yet uncultivated land, and no competition with cheap native labour.

The Chairman, in reference to competition with aboriginal labour, said that at any rate the Esquimaux would never be in the way, and even if they should, a more easily civilised people did not exist. He had had experience of them, and had found they were honest, and could be trusted to respect the rights of property, and to do no harm to anybody. It was a fact that their women were more clever than the men, and were always applied to by travellers for information. Their superior intelligence was no doubt attributable to the fact that, unlike other savage races, the Esquimaux did not make their women mere beasts of burden, but left them simply to the performance of their household duties. The nearest Esquimaux were, however, located in a portion of the territory which would not be settled for many years to come. With regard to another branch of the aboriginal population, the Indians of the Saskatchewan territory, to whom lands had been granted by the Canadian Government, were already beginning to cultivate the crops, and to breed cattle. The probable eventual separation of the colonies from the mother country had been alluded to in the discussion, and no doubt the separation would take place when the colonies found it convenient, but we should endeavour to part friends with them, and not try to coerce them, as we unhappily once tried to coerce the United States. They would then remain our friends, and send to us for what they want in preference to other countries. As to the suggested absorption of Canada into the United States, probably the Canadians were no more admirers than himself of the change of Government there every four years, with all its attendant political and financial disadvantages. The country had proved to be capable of raising a very hardy and powerful people. Several generations ago, a colony of Highlanders had gone out to a place called Glengarry, and their descendants had become still larger, more vigorous, and more powerful men, perfectly impervious to the cold, and he might say more Scotch than ever in their enthusiastic maintenance of the national customs. Personally, speaking of climate, he had been more tried here in London during the last ten days by the weather than he had ever been on an Arctic station in British North America. To fairly healthy people, the cold of Canada was stimulating. Physically, the conditions of the country varied, but, in the great fertile belt, the yield of crops was double that in the Western States of America, for whereas in that part of Canada the usual crop per acre was thirty bushels, an average crop in Minnesota, Illinois, and other Western States, gave only fifteen bushels to the acre. In Lower Canada, the French settlers had kept together *in families* on the same bits of land, which, though ample for one or two, would not suffice f a-dozen, and, consequently, a large part of Canada had suffered from over-stocking. The chewan Valley presented simply a succession of grass and pasture lands. Another point to b was the large ship-building trade of Canada. vessels were constructed there, and all their ships were built in the Canadas, Nova Scotia, Brunswick. It could not be disputed that the force there was as fine a body of men as exist world, accustomed to do everything for the and they were all naturally good shots, thei ing habits having taught them to judge di In conclusion, he proposed a hearty vote of th the lecturer.

Mr. Hall, in reply, said that the subject gration formed the gist of his paper, and he put Canada specially forward as the wealthie sources of our colonies. Upon the subject of th of Canada, he was glad they had had the adv hearing General Lowry, an old and tried offi Canadian forces. Had Captain Colomb been present, he would, no doubt, have given benefit of his knowledge on the subject.

General Lowry explained that he had gentleman on a bed of sickness, and that he regretted his inability to attend.

Mr. Hall, in continuation, acknowledged t of Mr. Edgcome's remarks on the colonisatic and on the possibility of a separation betwee and the mother country. Both sides of th ternational boundary in North America were Englishmen, and, therefore, something like of feeling, if not of political sentiment, migh for among them. No doubt, a kind of Z general customs, had been attempted in th terest, but that in no way showed antag desire on the part of the United States Canada. It was, in fact, much more lik been incidentally observed, that Canada w the United States. A very friendly comp sprung up between the two countries since t tion of the Reciprocity Treaty, and a large United States, notably in Massachusetts, ha its resumption, but the Canadians, he thougl ripe for that yet. They were satisfied with t national policy, and would probably rem many years to come. He had heard s Montreal about annexation two years ago, b for it did not exist among any very great p Canadian people, an overwhelming majorit were not only intensely loyal to the British flag, but immeasurably opposed to anything tion by the United States. As to the natio Cabots, he was aware they were not reside and he was indebted to Mr. Pfoundes for further information on the subject. They h always had the credit of being among the d this wonderful country, especially in the nei of he Nova Scotia coast. On the subject of schemes for the colonies, Mr. McCullagh lately expressed himself in favour of a joint and in that way probably the interests b mother country and the colonies who w our surplus population would be best consul Commission, to take into consideration the ject of colonial emigration, was what was place of the present system of emigration advocating his own particular colony. Havi watched the course of emigration during years, he was afraid that in too many insta sent out round posts to fill square holes, a scheme of emigration was urgently neede Mann had said, it was a great advantage to Canada that the aboriginal population, with labour, numbered but 100,000 to 4,500,000

hey were, however, of some use in that ; was very creditable to the Indian · Ottowa Government that they had ıake such good use of the aboriginal ınother extensive survey of the Hudson's being now made, and it would shortly ther the navigation of those waters in the year was really practicable. The mmerce were so great that the import- read-stuffs and conveying them directly ı's Straits to the British markets, in s, without transhipment, could not be

In conclusion, he thanked the meeting y and attention.

ı, pointed out that it was only now ad, by the opening up of Hudson's ailable a vast tract of prairie land npare with that of the United States, imate was preferable to that of the ht now be seen which of the two d attract the most emigrants from

hen adjourned.

ISCELLANEOUS.

RT NEEDLEWORK.

were once so famous for their pro- ıeedlework, that a particular kind of . *opus anglicanum*, and the productions were eagerly sought for abroad. In ıey lost their position of pre-eminence, ıteenth century, the *Spectator* censured ı for neglecting an employment eagerly mothers, and in the nineteenth century st died out of existence.

ladies of rank, with H.R.H., the an of Schleswig Holstein, at their e School of Art Needlework, in Sloane- twofold purpose of supplying suitable gentlewomen, and restoring orna- rk to the high place it once held among ts." The school was removed to its in Exhibition-road, in 1875, when the ed to grant the prefix "Royal" to it. lford, the vice-president, has described s had first to teach themselves, and how : from the exhibition of the needlework South Kensington Museum in 1872. ne of our difficulties lay in the catholic ature of our attempts. We tried to Renaissance, Plateresque, and Moorish, cobean, and even Georgian styles, s XIV., Louis XV., Louis XVI., all uiring each a life-long study. We ilk, velvet, thread and crewels on silk, and executed *appliqué* in all the styles ailed since style first began." In , the numbers in the school were 110 taff, making 130 in all, and it has con- . Work to the value of upwards of ıt to the Centennial Exhibition of 1876, and a collection of embroideries the International Exhibition at Paris ies have also been opened in several ill further to cultivate an interest in ıe art among the public, a special cient English and other art needle- re 1800, was organised by the school, e 28th of last month. Before alluding ief objects exhibited, we quote a few · Marian Alford's address (1875) on the history of needlework. She writes, "We have no fragments of classical embroideries, but though the stitches have escaped us, we have the materials employed—the gold, silver, and wools; we know their designs from frescoes, fictile vases, &c. What strikes us particularly is, that the forms are so fine, so graceful, so exquisitely simple, never naturalistic, and mostly similar to those employed in architecture. I said before that we have nothing of classical needlework; our earliest European specimens come out of the shadow of the dark ages, and are of the ninth and tenth centuries. They are all ecclesiastical, with one or two exceptions, such as the Bayeux tapestry, and all ugly. . . . Undoubtedly, the greatest teachers of embroidery have been the Persian, Indian, and Moorish schools. These influenced the Italians in their design and colouring; and there is another Oriental group, the Chinese and Japanese, very clever and inimitable in their own distinct lines, but far inferior to the first named, in splendour of colour, power of composition and combination, and in that simplicity and yet effectiveness which is sometimes the highest art. In the exhibition of embroidery, at the Kensington Museum, all these types were well represented, and one thing was worthy of note; after a little study, you found that you could almost always assign its place to each piece of work, and put the right date on it, as surely did the stitch and manner betray the period, as surely as the shadow on the dial marks the time of day."

Formerly, the chief demand for art needlework was from the church, and almost all the specimens of the twelfth, thirteenth, fourteenth, and fifteenth centuries, at the recent exhibition, were ecclesiastical work. The late Dr. Rock wrote of ecclesiastical vestments in England—"No kingdom in Christendom was better furnished with them, and their tissues were of the most beautiful and costly that might anywhere be found; ciclatoun, and baudekin, and every other cloth of gold, either plain or shot with colour, samit and satin, velvet, as soon as it was known, silks after all fashions, damasked, rayed, watered, clouded, or as the term then was, marbled; cloth of Tarsus, and fabrics from Saracenic looms were brought from afar, and put to the service of the liturgy as they came to hand." Some of the finest specimens exhibited were lent by the South Kensington Museum, one of these being the famous Sion cope, which is dated about the year 1250. Besides several copes, there were chasubles, dalmatics, maniples, corporals, and altar cloths. Much elaborate work was at one time lavished upon hearse-cloths or funeral palls:—

> "Each virgin soon apply'd
> Her ready skill, and wrought of golden thread,
> A costly net, which o'er a pall they spread
> Of finest silk."*

Most of the City companies had their palls, which were lent out for the burials of their members and members' wives. One of these, belonging to the Vintners' Company, was exhibited.

At the Reformation, the ingenuity of the ladies was diverted into entirely new channels, and embroidery was used for a very large number of varied objects. Although in the work of the previous centuries there was necessarily a considerable variety of stitch, still the general design remained somewhat similar, as the objects to be ornamented continued the same, but when the needle was free to work for secular objects, a considerable change in treatment became perceptible, and the subjects were adapted to the objects treated. In the reigns of Henry VIII., Mary, and Elizabeth, a very favourite covering for books was embroidered velvet, and this taste was continued for long after their reigns. There was at this Exhibition a Prayer-book and Bible in red velvet covers, embroidered in gold and silver

* Hoole's translation of "Orlando Furioso," B. xxii.

thread work in relief, with the royal arms, rose and thistle, and C.R. (Charles I.). The nieces of Nicholas Ferrar, who lived at the manor house of Little Gidding, Huntingdonshire, called by the common people the Protestant nunnery, were great proficients in the art of needlework, and they produced a large number of embroidered covers for books, besides many other beautiful objects. Some years ago, three fine portraits in needlework, by these so-called nuns of Little Gidding, were exhibited at the Ironmongers'-hall. One of these was of the Virgin Mary, represented as "Queen of Heaven," in an oval wreath, at the angles of which are the pomegranates of Aragon. The second was a portrait of Edward VI., six inches square, and the third a portrait of Queen Elizabeth, of the same size as the second. The greater number of articles exhibited by the School of Needlework in illustration of the work of the sixteenth, seventeenth, and eighteenth centuries are wearing apparel, but in the eighteenth century there were several specimens of embroidered and painted silk and satin work, which were copies of engravings or pictures. In the sixteenth century, English ladies were famous for working carpets, which were used for hangings and table-covers. In 1548, George Lord D'Arcy left to his daughter Agnes, wife of Sir Thomas Fairfax, his "best wrought silk carpet, bordered with crimson velvet, which she made," and Sir William Drury, of Hawsted, County Suffolk, bequeathed to his wife, Elizabeth, "one carpitt for a cupboard, of those which were of her own making." In addition to the old English needlework, which formed the bulk of the Exhibition, there were some selected specimens of the chief European nations, besides a few pieces of Turkish, Japanese, and Persian work.

GLUCOSE MANUFACTURE.

The following particulars respecting the glucose industry, which has grown to large proportions in America during the past fifteen years, are obtained from the *Journal of Applied Science*:—There are at present ten glucose factories in the United States, running day and night, consuming 21,000 bushels of corn per day, each bushel yielding, on an average, 28 pounds of glucose. These figures would indicate a yearly production of over 200,000,000 pounds. That the business is a profitable one, would appear from the fact that it has at least doubled every year for the last five years. Large quantities of the products of the glucose factories are now exported to Europe, manufactories being able to furnish a cheaper and superior article to that made abroad from potatoes.

The principal object of the originators of this industry in the United States, we are informed, was to manufacture syrup, and from this the application of the products have widely extended. The glucose syrup is not so sweet as cane syrup, and has a lighter colour; and when mixed with the latter it improves its colour, though the saccharine strength or sweetness is impaired. The use of glucose for this purpose has come to be very general, and though even at the present time the business is largely conducted in a surreptitious manner, there are some manufacturers who openly acknowledge that they employ glucose in their syrups, and defend its use for that purpose.

The glucose is likewise largely used by brewers, distillers, and vinegar makers; for sizing paper, for making printers' inking rollers, and other uses. The grape sugar, under which term the manufacturers designate the solid portion of their product, is known to have been for some years quite largely used by confectioners, brewers, and others. Now, however, it is added in the proportion of from 12 to 20 per cent. to cane sugar, and in this form the mixture is brought into the market under the mame of "New Process Sugar." As in the case of the corn syrup, the addition of corn sugar to the cane sugars distinctly improves the colour of the latter,
decidedly reduces its sweetness, which is of
real test of the value of either syrup or
these explanations it will have been made
colour, which has hitherto been regarded
indicators of the quality of saccharine
longer be so regarded.

The enormous growth of the business of
and sugar for corn has awakened the very
picion that these products are extensively
adulterating cane syrups and sugars, and
latter; and there is little doubt but that this
falsification is carried on, though to what
impossible at present to say. Corn sugar
are not unwholesome; on the contrary, they
looked upon as quite as wholesome as cane
syrup. The fraud comes in where the corn
which are cheaper and of less saccharine
palmed off upon the public for what they are

HEMP CULTIVATION IN MEXIC

The hemp industry in Mexico has, within
or twelve years, attained considerable propo
one of the chief articles of trade in Yucatan,
extracted from the hemp plant, or Am
commonly called by the Indian name of "h
Consul Lespinasse states that the plant is fo
fusion throughout Yucatan, and forms t
whence all the present hemp plantations
formed. The hemp tracks are divided into "
which is a Mexican measure of 24 yards squ
all the shrubs and weeds have been burned
previous dry season, the Indian labourers pr
small pits, in a straight line, from six to
apart, and between each line of pits, a path
feet wide is left clear, in order to give th
sufficient room to cut the leaves when
attained their full growth. As soon as t
quantity of land is thus laid out, the youn
cut close to the ground, and, without any
cess, are simply placed in the pits prepare
with a little loose earth, and are left to
themselves. Each "meccate" contains abou
Twice a year the ground is cleared of the
As the plant grows, a stem shoots ou
centre, and the leaves gradually detach
from it in a spear-like form, with sharp p
the edges, and a strong, black, sharp needl
at the point. The plant requires from fi
years to attain its full growth. At the
period, the leaves have an average length o
A hemp plant will flourish from 10 to 15 y
plant has about 26 leaves during the yea
rainy season, and 10 in the dry; each le
long, produces about three-quarters of a
fibre; it requires, therefore, from seve
thousand leaves to make a bale, weighing f
pounds. As soon as the plant has attai
growth, the leaves are cut from the trunk,
from the bottom upwards, only those bein
are well developed. From the hemp be
carried to the scraping-machine, which
strong fly-wheel, on which six or eight
knives are placed transversely. The leave
one by one on a curved lever, which is raise
in such a manner that the knives on the
strike the pulp and lay bare the fibre. Fi
of the leaf is presented to the wheel, and as
scraped the other end is presented. Each t
is introduced, the other is secured by a st
iron pliers, which are attached to the mac
machine employs four men, one to place the
the machine, one to attend the lever, one t
the leaves into the machine, and the fou
away the pulp and refuse matter. As

worked by steam-power, and can clean undred pounds of fibre in one day. When extracted from the leaf, it is taken to the and hung on slender poles, which are wooden frames about three feet from the left to dry and bleach in the sun. If the e, it will become dry in four to five hours. , the fibre loses its natural greenish hue, a white, glossy appearance. It is then draulic presses, and compressed into bales red size, which generally weigh three fifty, four hundred, and five hundred e fibre is then ready for shipment.

INDUSTRY IN QUEENSLAND.

port on this subject by Mr. Henry Ling ars that the crops of sugar in this colony 1879 (that is 31st April, 1879, to 31st to about 18,200 tons, or about 4,500 tons f the previous year. The approximate four sugar districts was:—

rn district	about	2,200 tons.
l ,,	,,	5,750 ,,
y ,,	,,	9,500 ,,
ell ,,	,,	750 ,,

for 1880 is estimated at 21,000 tons, which a low estimate. As far back as 1823, the nas Scott grew the sugar cane successfully tronage of Sir Thomas Brisbane, then l succeeded in obtaining 70 tons in 1827, at e in New South Wales. This venture was th the aid of convict labour placed at Mr. al by the Governor, but, on the removal , the sugar establishment was broken up. pts were subsequently made to establish stry without effect. Throughout Moreton to its separation in 1859 from New South formation into Queensland, the sugar cane l in the gardens of several people, so that e doubt as to the possibility of its culture. ar known to have been produced in Queens- le by Mr. Buhôt, of Barbadoes, from cane e Botanic Gardens, Brisbane, in May, 63, Captain L. Hope had twenty acres ad the Society of Arts offered a medal for f sugar made in any of the colonies. By 7, there were 20,000 acres under cultivation the six mills in existence manufactured 168 At the close of the season of 1869 there at work crushing the cane from 1,230 over 5,000 acres under cultivation. In on turned out very bad, the cane, nearly vet, became unhealthy and died, giving eturns. In the course of time the evil passed away, and the sugar industry has n, more or less of a success. The average r per acre, in Queensland, for the ten 31st March, 1879 (and including the rust as follows:—

	cwt.	qrs.	lbs.
district	24	0	25
,,	24	2	9
,,	27	0	23
,,	30	1	2
nd ,,	25	3	0

es may be compared with the yield of s, as in the following table:—

	Average yield per acre. lbs.
	4,480
	1,200
	3,500 to 5,500
	1,344
Philippine Islands	2,800 (This has been stated as only 1,680 lbs.)
India	896
Rio Janeiro	2,100
Java	about 3,360

Mr. Roth writes respecting these figures:—"According to Porter, virgin land used to give 5,000 lbs. of sugar per acre, and Edwards, in his 'History of the West Indies,' speaks of soil in Jamaica, which with plant cane will produce 2½ tons (5,600 lbs.) of sugar to the acre. Now, in Queensland, 3½ tons and over, or above 7,840 lbs. per acre, have occasionally been obtained from soils newly broken up, but such a yield is exceptional." The manufacture of rum has increased at the same rate as that of sugar. The total production since 1867 was 1,842,322 proof gallons. Up to 1876, the yield was at the rate of over 2 gallons of molasses fermented to 1 proof gallon of rum distilled. For 1877, it was at the rate of 1¾ to 1, and in 1878, at the rate of 2 to 1.

The mean consumption of sugar in Australasia is greater than in any other part of the world. The consumption of sugar and molasses in England for 1878 was at the rate of 62½ lbs. per head. Australasia, however, consumed 78·7 lbs. per head, or 16 lbs. per head more than England did. Of the colonies, Queensland is the greatest, and South Australia the smallest consumer, their consumption being 92·13 and 71·31 lbs. respectively. Australia draws her supplies from various quarters. Of the 91,500 tons which went into consumption in 1878, one-sixth was produced by Queensland, and one-twelfth by New South Wales, thus one-fourth of the sugar consumed in Australasia is produced in Australia itself. The remaining three-fourths are imported chiefly from Java and the Mauritius, supplemented by small supplies from the minor sugar-producing countries.

A WHOLESOME HOUSE.

"F.R.C.S." has written a letter to the *Times* under this heading, which contains a narrative of his efforts to convert an old London house into a perfectly wholesome and comfortable habitation. His first work was to empty and fill up the cesspools, over which he was living, and connect the home with the street sewer, which had not previously been done. The writer says:—"I had furnished the house in the way common to habitations of its class. There were window curtains in the dining-room, window curtains in the consulting-room, window curtains in the drawing-room, window curtains in the bedrooms. There were carpets on all the floors; there were unprotected papers on the walls; there were wardrobes and other pieces of furniture, which had their apparent height increased by cornices, within which were hollow spaces, seemingly made on purpose to form harbours for dirt. There were ponderous book-shelves, containing a formidable amount of printed lumber, and a still more formidable amount of dust. The walls were old, with uneven surfaces, and to these uneven surfaces dirt clung with an almost touching tenacity. There were all sorts of fluffy things about, which were supposed to be ornamental, fancy mats and the like, and which blackened the fingers of any one bold enough to touch them. Last, but by no means least, there were the ever-increasing accumulations of rubbish, such as old clothes, old toys, old books and pamphlets, old newspapers, old music, and miscellaneous trumpery of every description. Upon all these things the dirt of a London street poured in without intermission. In dry weather the dust found its way through every chink; in wet weather the feet of visitors brought in mud, which dried into dust speedily. If the children romped for ten minutes in a carpeted room, the dust would lie in a thick layer upon the tables and chairs

when they had finished. Dirt seemed to be omnipresent and all-pervading. It was plentiful in the air we breathed, it mingled with the food we ate, and with the liquids we drank. The principle upon which I started was that the house, for the future, should be kept wholly free from superfluous contents, that all dirt-traps, whether fixed or movable, should be abolished, and that all surfaces should be rendered washable. The first thing was to send away cartloads of the varied material which I have already described as rubbish, the terms including all carpets, all window curtains, all the muslin blinds which people hang across the lower halves of bedroom windows, all books and pamphlets which were not really required, all antimacassars and the like, everything that was broken, and everything that was useless. Having thus cleared the ground, I commenced the work of reform. The first thing, of course, was to see carefully to the drainage and water arrangements, to the ventilation of soil-pipes, the condition of cisterns, and so forth; but in these respects there was not much to be done. The next thing was to cover the old floors with thin oak parqueterie, both in living-rooms and in bedrooms. Upon the parqueterie floors I have a few small Oriental rugs, each of which can be taken up and shaken in one hand. The next thing was to have every unfixed wardrobe, sideboard, or other piece of heavy furniture placed upon castors, so that it might be easily moved by the housemaids, and the wall and skirting behind it kept free from dirt. At the same time the top of every wardrobe and cupboard was levelled by a cover of thin planking or of stretched canvas covered by brown paper, so that all these surfaces could be wiped down frequently and kept perfectly clean. The painted woodwork generally was not only painted, but also varnished; and the wall papers were all varnished, with the exception of one, which was painted. Ventilation is provided for, both in sitting-rooms and bedrooms, by that old system of vertical tubes communicating directly with the outer air, to which attention was recalled some few years ago by Mr. Tobin. Outside the house the external portions of these tubes are bent vertically downwards for a few inches, a method by which the quantity of air-borne dirt which would otherwise enter through them is very materially diminished. In the dining-room the tubes are brought up through ornamental cylinders of Doulton ware resembling vases, but made for the purpose without bottoms, and placed upon wooden plinths of similar construction. In the bedrooms the surfaces of the tubes are painted the colour of the adjacent woodwork; and in some of the upper rooms I have been content with a simple board, about 5in. high, covering the lower part of the window opening, and serving to direct the entering air upwards when the sash is raised to a somewhat smaller extent. With this board the bedroom windows may be left open all night, both rain and direct draught being excluded."

In conclusion, "F.R.C.S." says that he wishes to pay a grateful tribute to Mr. R. W. Edis, from whose Cantor Lectures, delivered before the Society of Arts in 1880, he derived the suggestions which first led him to think of perfect cleanliness as the highest domestic virtue.

SWISS CENSUS OF 1880.

The Geneva Correspondent of the *Times* gives the following particulars respecting the recent census of Switzerland, of November 30, 1880. The population of Switzerland on the night of November 30, as given in the official returns, amounted to 2,831,787. In 1870 it amounted to 2,655,001; in 1860, to 2,510,794; in 1850, to 2,390,116. Hence in the first of these decennial periods (1850-60) the yearly increase was 11,219, in the second 14,494, in the third 17,679. In 30 years the population has increased 441,671, equa an average of 14,387 a year. As may be supposed, rate varies greatly in different parts of the country. some cantons there has been a decrease. One cant Aargau, shows a falling-off in every decennial per since 1840, except in the ten years between 1860 a 1870, and its population is now less than it was years ago. The cantons wherein populations h most increased are Basel city, Uri, Zug, Neuch and Geneva. The population of Basel has risen f 29,555 in 1850 to 64,207 in 1880, an augmenta which is explained by its proximity to Ger and the number of German refugees who have tak their abode in the district. An analogous cause, nearness of Geneva to France, accounts in great pa the fact that the population of this canton has g from 63,000 in 1850 to 99,000 in 1880. For alt many French exiles have taken advantage of amnesties to return to their own country, not have formed connections and attachments in the bourhood, and will probably remain there all lives, the more especially as by doing so they as well for themselves as their children, the bur compulsory military service. The increase in the p lation of Uri and Zug arises from the presence in cantons of workmen and others employed on the Gothard railway works. The increase of populati Switzerland at large during the 30 years ending has been at the rate of 5·50 per 1,000 per year. the first half of the period in question the increa rather under this proportion, for the second half over. Compared with the rate of increase in countries, the rate in Switzerland is far from being Thus the rate per year per 1,000 in England in Scotland, 9·3; in Denmark, 11·1; Sweden, Norway, 8·6; Prussia, 10; Saxony, 15·6; Holland, Belgium, 8·2; Italy, 7·1. There are only three Eur countries in which the progress of population is than in Switzerland, namely, Bavaria, 5·4; Ireland and France, 2·3. The natural growth of the popu of the Confederation in the time under review—th the excess of births over deaths—was 200,828; b the actual increase was no more than 176,786, it f that the country lost 24,112 individuals by emigr The real loss, however, was probably not so gr these figures might seem to imply, for when the c of 1870, the basis of the comparison, was taken, thousands of French people, the remnants of Bour army, French refugees and others, were included i count. The report from which I quote enters i curious calculation as to the economic effect of ments of the home population. For instance, bet 1870 and 1880, Aargau lost by migration the wh the natural increase of its population; in other w although the births exceeded the deaths by 19,0 population diminished by 400. The population of increased over and above its natural increase 13,344, many of the new-comers being nati Aargau. As young people in Switzerland do not about much until they have finished their schoo is safe to conclude that the immigrants w the average at least 16 years old. Taking year with another, it is assumed that a child c be brought up to its 16th year for less than francs (£74), which, seeing that the basis o calculation is only £4 15s. 10d. a year, cann considered an excessive estimate. But as those 1 grown children were the survivors of 19,000, whom have cost something, it is considered th total cost of their rearing ought to be put at £103 each. Hence Zurich by this, so to speak, un increment of its population made a gain, or an eco of 34,479,000 francs (£1,380,000) at the exp Aargau and the other districts that may have tributed to the increase. If we assume, on the hand, that the migrating Argauers went to the States, and adopt the American estimate, which

c equivalent of every new-comer at 800 dols., States would be indebted to the little canton with its 198,000 inhabitants, for an addition onal wealth, between 1870 and 1880, com- £2,120,000. According to a return lately o the Federal Council, the *elite* of the army in regular training liable at any time to be for active service) is composed of eight with an effective strength of 117,759 men. st of these divisions is 11,745, the most 7,052 strong. The landwehr, who, having igh a regular course of drill, are mustered inspection only, made an effective force of fence, in case of need, Switzerland could the field fully 200,000 men, all fairly dis- id many of them first-rate shots."

; WAX PALM IN PERNAMBUCO.

icis T. Eaton sends some further particulars this palm, described in the last number of l :—

', or vegetable wax (not Camanba) is the f the leaves of the Carnauba Palm (*Cory- ;* natural order, *Palmaceæ*), one of the is of the Brazilian forests. Its fan-like placed in a tuft at the top of a hard solid ing from 30 to 40 feet in height, the stalks es themselves being 6 or 8 feet in length. leaves have attained perfection, they are e varnished with a thin coating of vegetable r are then gathered and laid in a cold dry cloths, where they naturally wither and a consequence of the shrinking, the coat of , and peels off in small flakes; these are from e collected, and it is turned out when melted earthen pans, and then cooled. The lumps d), are about 3 and 4 lb. each, and bear the e pan in which they have been melted; it is lphur colour, with a lustre between that of rosin, and rather brittle. There were im- Liverpool, in 1878, 80 tons; in 1879, 13 in 1880, 40 tons, and the value has ranged s. and 85s. per cwt.

GENERAL NOTES.

Museum.—Mr. Albert Grey, M.P. for rland, has given the following notice:—"On Committee of Supply in Civil Service Estimates atent-office), to draw attention to the inefficient tion now provided for the Patent Museum at sington; and to move that the time has come ilding worthy of the nation, and calculated to manufactures of this country, should be erected urplus funds that have been derived from taxes n." From Mr. J. Howard's return, ordered 1800, it appears that the excess of receipts over has been since 1866 to 1879 upwards of

clamation in Florida.—It is reported in the at the Philadelphia capitalists who are about to immense tracts of land in the State of Florida e Everglades, have completed their contract with one of the main features of the scheme being the a ship canal across Florida. This project almost portance that of reclaiming 12,000,000 acres of It would not only shorten the distance between an ports on the Atlantic coast and all European w Orleans, Mobile, and all shipping points on the xico, but it would avoid the dangers to naviga- are experienced on the countless keys and coral southern and south-western coast of Florida.

Sanitary Exhibition.—The allotment of space in the International Medical and Sanitary Exhibition to intending exhibitors is being proceeded with, and at the last meeting of the committee the names of 225 exhibitors were registered and approved as follows:—Medical section, 115; sanitary section, 94; miscellaneous section, 16. In addition to the wall space and counter space taken, upwards of 1,200 feet frontage of floor space will be allotted to the above exhibitors, representing an area of no less than 8,000 square feet. This area will be occupied by articles which are said to be strictly within the object of the exhibition. The list of exhibitors already includes the leading manufacturers in Great Britain and Ireland in connection with the medical industries, and the industries connected with architecture and sanitary engineering, and important exhibits are said to be announced from France, Germany, Austria, Italy, Belgium, Holland, Norway, and the United States. The time for receiving applications for space came to an end on Saturday last, 16th inst.

Resistance to Bending of Tempered Glass.—At a recent meeting of the Académie des Sciences, M. de la Bastie communicated some data as regards the resistance to deflection of tempered as compared with ordinary glass. It appeared from a first series of thirty-six experiments that:—(1) The elasticity is more than doubled in the tempered glass; (2) single tempered glass possesses a resistance about two and a half times greater than ordinary double glass; and (3) semi-double tempered glass is about three times stronger than ordinary double glass. A second series of forty-three experiments showed that:—(1) While the deflections assumed by ordinary glass are so slight that they cannot be registered, tempered glass deflects to an appreciable extent under a load; (2) tempered plate-glass, varying in thickness from 6 to 13 millimètres (about a quarter to half inch), possesses a resistance 3·67 times greater than that of ordinary plate-glass of equal thickness; (3) tempered unpolished glass is about 5·33 times stronger than ordinary unpolished glass.

Tobacco from China.—In his last report from Hankow, her Majesty's Consul writes that the supply of tobacco is so large from the provinces of which the mighty Yangtsze-kiang forms the market-road, and the leaf so fine in colour, texture, and fragrance, that merchant after merchant has felt convinced that it ought to form a profitable export; but, though in past years it was sent to America to aid in the manufacture of Havanas, and also to England for similar purposes, it has not until quite lately proved a remunerative investment. It is now, Mr. Alabaster believes, used for the manufacture of cigarettes, under the name of Turkish tobacco, and for mixing with various cut tobaccoes in this country; but he goes so far as to express his conviction that, when better known, it will be smoked on its own merits. Mr. Alabaster only refers to the unprepared leaf-tobacco, as the prepared article, from the nature of the process it goes through, has a taste somewhat nauseous to the foreign palate. In twelve months, close upon eight million pounds of this leaf tobacco were exported from Hankow in foreign bottoms alone, without taking into consideration the amount shipped in native junks; the estimated value being given at about £120,000.

Cost of Electric Lighting.—The following particulars of the cost of electric lighting in the City are given in the *Citizen*. In the district allotted to the Anglo-American Electric Light Company (Brush light), comprising Blackfriars-bridge, New Bridge-street, Ludgate-circus, Ludgate-hill, St. Paul's Churchyard, Cheapside (western end to King-street), 32 electric lamps, at a cost for the year of £1,410, are substituted for 150 gas lamps, costing annually £650 (including lighting and cleaning), thus making the cost of the experiment in this district but £760 above the ordinary outlay for gas; but, deducting the cost (estimated at £750) of providing and fixing the electric machinery and lamps, and removing the same at the expiration of the contract, the expense, as near as possible, is the same as for gas. In the district comprising London-bridge, Queen-street, King-street, Poultry, Guildhall-yard, Mansion House-street, Royal Exchange, and King William-street, assigned to Messrs. Siemens Brothers, 32 electric lamps (including six large ones) will be employed in lieu of 188 gas lamps. The amount of this contract is £3,720. The sum saved by non-consumption of gas is about £600. The amount estimated for providing and removing the electric machinery and lamps at the expiration of the contract is 1,450, so that the cost, compared with gas, is 8½ more.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at eight o'clock:—

April 27.—"Five Years' Experience of the Working of the Trade Marks' Registration Acts." By Edmund Johnson. Theodore Aston, Q.C., will preside.

May 4.—"Buying and Selling; its Nature and its Tools." By Professor Bonamy Price, M.A. Lord Alfred S. Churchill will preside.

May 11.—"The Manufacture of Glass for Decorative Purposes." By H. J. Powell (Whitefriars Glass Works). William Spottiswoode, LL.D., P.R.S., will preside.

May 18.—"The Electrical Railway, and the Transmission of Power by Electricity." By Alexander Siemens. Dr. Siemens, F.R.S., will preside.

Foreign and Colonial Section.

Tuesday evenings, at eight o'clock:—

May 10.—"Trade Relations between Great Britain and her Dependencies." By William Westgarth.

Applied Chemistry and Physics Section.

Thursday evenings, at eight o'clock:—

April 28.—"Impurities in Water, and their Influence upon its Domestic Utility." By G. Stillingfleet Johnson, F.C.S. Allen Thomson, M.D., F.R.S., will preside.

May 12.—"Recent Progress in the Manufacture and Applications of Steel." By Prof. A. K. Huntington.

May 26.—"Telegraphic Photography." By Shelford Bidwell. Prof. W. G. Adams, F.R.S., will preside.

Indian Section.

Friday evenings, at eight o'clock:—

April 29.—"The Building Arts of India." By General Maclagan. Andrew Cassels, Member of the Indian Council, will preside.

May 13.—"Burmah." By General Sir Arthur Phayre, G.C.M.G., K.C.S.I., C.B.

Members are requested to notice that it may be necessary to make alterations in the dates of the above papers.

Cantor Lectures.

Monday evenings, at eight o'clock:—

The Fourth Course will be on "The Art of Lace-making," by Alan S. Cole. Four Lectures.

Syllabus of the Course.

Lecture III.—May 2.

Fringes. Twisted thread-work in England in the 15th century. Early designs for plaited and twisted threads. Italian, Flemish, French, and English pillow lace. Laces of primitive design.

Lecture IV.—May 9.

Resumé as to styles of design in hand-made lace. Traditional patterns. Sketch of the development of inventions for knitting and weaving threads to imitate lace. Differences between machine and hand-made laces. Modern hand-made laces at Burano, Bruges, Honiton, &c.

This course will be illustrated by specimens of lace. Diagrams and photographs enlarged will be shown by means of the lantern and oxyhydrogen light.

The Fifth Course will be on "Colour Blindness and its Influence upon Various Industries," by R. Brudenell Carter, F.R.C.S. Three Lectures. May 16, 23, 30.

Admission to Meetings.

Members have the right of attendin Society's meetings and lectures. Ever can admit *two* friends to the Ordinary anc Meetings, and *one* friend to the Cantor Books of tickets for the purpose have b to the Members, but admission can also b on the personal introduction of a Memb

MEETINGS FOR THE ENSUING W

Monday, April 25th...British Architects, 9, Condu 8 p.m. Mr. J. Slater, "Electric Lightin Buildings."

Institute of Actuaries, The Quadrangle, K W.C., 7 p.m. Mr. Harald Westergaard, " Mortality of the Danish Clergymen from 1

Medical, 11, Chandos-street, W., 8½ p.m.

London and Middlesex Archæological S Martin's-place, W.C., 8 p.m. Rev. H. "A Dismal Depression in Drapery, 1622."

Tuesday, April 26th...Royal Institution, Albemar 3 p.m. Prof. Dewar, "The Non-Metalli (Lecture I.)

Medical and Chirurgical, 53, Berners-st street, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Walter R. Browne, " Value of Upland and Tidal Waters in prod

Anthropological Institute, 4, St. Martin's 8 p.m.

Royal Horticultural, South Kensington, S.

Wednesday, April 27th...**SOCIETY OF ARTS** Adelphi, W.C., 8 p.m. Mr. Edmund Jo Years' Practical Experience of the W Trade Marks' Registration Acts."

Geological, Burlington-house, W., 8 p.m Mackintosh, "The precise mode of and derivation of the Moel Tryfan Shell the discovery of similar High-level Dep eastern slopes of the Welsh Mountain existence of Drift-zones showing Proba in the rate of Submergence." 2. Mr. E. V on a Mammalian Jaw from the Pur Swanage, Dorset." 3. Rev. J. F. Blake lation of the Upper Jurassic Rocks of those of the Continent." 4. Mr. A "Fossil Chilostomatous Bryozoa from th Victoria, Australia."

Royal Society of Literature, 4, St. Martin' 4½ p.m. Annual Meeting.

Sanitary Institute of Great Britain, 9, Cond 8 p.m. Resumed discussion on the A Richardson, "Suggestions for the Manag of Small-pox and of other Infectious I Metropolis and large Towns."

London Institution, Finsbury-circus, E Annual meeting.

Thursday, April 28th...**SOCIETY OF ARTS** Adelphi, W.C., 8 p.m. (Applied Chemist Section.) Mr. G. S. Johnson, "Impuri and their Influence upon its Domestic Ut

Royal, Burlington-house, W., 4½ p.m. 1. M son, "The Influence of Stress and Strain of Physical Forces." 2. Mr. W. K. Metamorphosis of Lucifer: a Study in M

Antiquaries, Burlington-house, W., 8½ p.m.

Society for the Encouragement of Fine Ar street, W., 8 p.m. Mr. J. R. Sawyer, " Processes as Applied to Fine Art Reprodu

Royal Institution, Albemarle-street, W., Tyndall, "Paramagnetism and Di (Lecture I.)

Inventors' Institute, 4, St. Martin's-place,

Royal Society Club, Willis's-rooms, St. J 6 p.m.

Friday, April 29th...**SOCIETY OF ARTS,** Adelphi, W.C., 8 p.m. (Indian Secti Maclagan, "The Building Arts of India."

Zoological, 11, Hanover-sq., W., 1 p.m. An

Royal Institution, Albemarle-street, W., Meeting 9 p.m. Prof. Blackie, "The I Literature of the Scottish Highlands."

Geologists' Association, University Colleg cursions to Charlton and Blackheath, un tion of Dr. Logan Lobley.

National Health Society, 23, Hertford-stre (Drawing-room Lectures.) Prof. Flee "Sanitary House Inspection."

Saturday, April 30th...Royal Botanic, Inner-cir park, N.W., 2 p.m. Exhibition of Spring

Royal Institution, Albemarle-street, W., Henry Morley, "Scotland's Part in Englis (Lecture I.)

L OF THE SOCIETY OF ARTS.

No. 1,484. Vol. XXIX.

FRIDAY, APRIL 29, 1881.

...ations for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

...RT WORKMANSHIP EXHIBITION.

...parations for the Exhibition of Works of ...d to Furniture, at the Royal Albert Hall, being proceeded with. The available ... been divided amongst the following ...o will afford facilities to exhibitors of ...hich may be considered as accessories of such articles to be shown in company specimens of art furniture exhibited:— . G. Crace and Son; Morant, Boyd, and Jackson and Graham; Gillow and Co.; ...nd Sons; Howard and Sons; Wright and ; Collinson and Lock; Gregory and Co.; ... and Co.; and Johnstone, Jeanes, and Exhibition will open on Thursday, 12th ...he same time as the General Art Exhi- the Albert Hall, and it is proposed to Exhibition open until the end of July.

DOMESTIC ECONOMY CONGRESS.

...ing of the General Committee of Ladies ...ove Congress was held at the Society of Wednesday, the 27th April, Sir Henry .C.B., in the chair. Present:—The of Airlie, the Viscountess Harberton, ...arlotte Schrieber, Lady Blanche Hozier, ...le, Mrs. Cotton, Mrs. Floyer, Mrs. Mrs. Hollond, Mrs. Lecky, Mrs. Mann, ...loe, Miss Cole, Miss Hooper, and Miss ...cester. Lord Alfred S. Churchill, Major- ... C. Cotton, C.S.I., Rev. J. Faunthorpe, Rev. Newton Price, members of the ...e Committee, were also present.

...EEDINGS OF THE SOCIETY.

...NETEENTH ORDINARY MEETING.

...sday, April 27th, 1881; Theodore ...C., in the chair.

The following candidates were proposed for election as members of the Society:—

Allison, Herbert John, 41, Southampton-buildings, Holborn, W.C.
Baggallay, Henry Charles, 4, Ada's-avenue, Hull, Yorkshire.
Blakesley, John Holmes, M.A., 23, Fopstone-road, South Kensington, S.W.
Elliott, William St. George, M.D., 39, Upper Brook-street, W.
Favarger, Henri, 75, Turnmill-street, E.C.
Heseltine, Francis J., Westminster Palace Hotel, Victoria-street, S.W.
Inglefield, Admiral Sir Edward, K.C.B., 99, Queen's-gate, South Kensington, S.W.
Keefe, John, Colquitt-chambers, 6, Colquitt-street, Liverpool.
Longworth, William, Guildford, Surrey.
Matthay, George, F.R.S., Cheyne-house, Chelsea Embankment, S.W.
Ramsden, John Carter, Gristhorpe-hall, near Filey, Yorkshire.
Ravensworth, Earl of, 9, Mansfield-street, W.
Severn, Walter, 9, Earl's-court-square, S.W.
Snape, William, J.P. (Mayor of Over Darwen), Lynwood, Darwen, Lancashire.
Sproston, Hugh, Hughville, South Norwood, S.E., and Demerara.
Thornton, Edward, C.B., Bank-house, Windsor.
Warren, W. J., Cotford-villa, Bournemouth.

The following candidates were balloted for, and duly elected members of the Society:—

Culley, William Richard, 15, Maryon-road, Charlton, S.E.
Dale, George Williams Melville, Ellerslie, Nether-street, North Finchley, N.
Davis, Moses, 27, Wellclose-square, E.
Knight, William Duncan, Avening-house, Greenhill, Hampstead, N.W.
Mackie, John, 2, Victoria-villas, Queen's-road, Reading.
Pope, Joseph John, M.R.C.S., 4, South-crescent, Bedford-square, W.C.
Rowan, Arthur Hill, 6, Westminster-chambers, S.W.
Thornhill, George, C.S.I., 36, Eastbourne-terrace, W.

The Chairman, in introducing Mr. Johnson, said the subject of trade marks was one of great national, and even international, importance. The system introduced by the new law was entirely new, and the law itself in many points was defective, in not expressing what ought to be done in order to carry out its enactments. Much credit was due to Lord Cairns for the attention he paid to the subject, and the care with which the rules were drawn up, but the matter being entirely new, a great deal was left unprovided for, which experience had shown might and ought to have been enacted. If those present would, at the conclusion of the paper, favour the meeting with their suggestions as to what might be done to carry out the intention of the Act, they would render great service to the commercial community.

The paper read was on—

TRADE MARKS.

By Edmund Johnson, F.S.S., F.Z.S.

Honorary Secretary of the London Trade Marks Committee.

The law relating to trade marks is founded on an accumulation of judicial decisions of our Chancery Judges, based upon the common law of the land and on principles of equity; and was well established before the Trade Marks Registration Act of 1875 came into operation.

It cannot be too clearly stated that the object of the Act was not to interfere with existing rights or to alter the general law, but, as its name infers, to devise a system of registration for trade marks; and, incidentally, its effect has been to render registration compulsory, by debarring those owners whose marks were not registered before the 1st July, 1876, from the right to institute proceedings to prevent infringement.

I desire to confine my attention, as closely as possible, to the practical experience gained in connection with applications for the registration of trade marks under these Acts; and, in the course of these observations, I shall have occasion to mention some important and leading judicial decisions bearing upon the subject, and to suggest some alterations which, I venture to think, will meet with the general approval of those interested in trade marks.

The Act of 1875 provides for the establishment of a registry. It enacts, *inter alia*, that a trade mark must be registered as belonging to particular goods or classes of goods; that registration of a person as first proprietor of a trade mark shall be *primâ facie* evidence of his right to the exclusive use of such trade mark, and shall, after five years from registration, be conclusive evidence of his right to the exclusive use of such trade mark. Section 10 of the Act thus defines a trade mark:—

"For the purposes of this Act, a trade mark consists of one or more of the following essential particulars; that is to say:—

"A name of an individual or firm printed, impressed, or woven in some particular and distinctive manner; or

"A written signature or copy of a written signature of an individual or firm; or

"A distinctive device, mark, heading, label, or ticket;

and there may be added to any one or more of the said particulars any letters, words, or figures, or combination of letters, words, or figures; also

"Any special and distinctive word or words or combination of figures or letters used as a trade mark before the passing of this Act may be registered as such under this Act."

The Act also contains various provisions as to applications to the Chancery division, for rectification of the register and as to the framing and varying of rules.

The Amendment Act of 1876 extended the prescribed period for registration for one year, and introduced a very important new feature in providing for the granting of certificates of refusal in respect of such old marks as could not be registered under the Act of 1875.

The Act of 1877 extended the date for the registration of marks used in textile industries (Classes 23 to 35) to the 1st July, 1877, or such further date as might, by Order in Council, be determined.

Rules.—The first schedule to the Rules, settled and published by order of the Lord Chancellor, contains a list of the fifty classes into which goods are distributed for the purposes of registration, in one or more of which every mark must be registered.

The statement containing the application for the registration of a trade mark must specify the goods with respect to which the mark is to be registered, and in the case of a trade mark used before the passing of the Act, must particul[illegible] the goods in respect of which it has been used, the length of time so used.

Other provisions are contained in the rules [illegible] reference to the advertisement of the appli[illegible] and notice of opposition, as to which I need [illegible] here make any special reference. I may [illegible] remark that they are framed with ability, and [illegible] been carried out by the Trade Marks Registry [illegible] such a manner as to merit and secure general [illegible] faction.

Classification.—The classification of goods [illegible] respect of which trade marks are registered in [illegible] fifty different classes has been found on the wh[illegible] to work well. It was prepared upon the basi[illegible] the system adopted in connection with most of [illegible] leading International Exhibitions. Some cla[illegible] are very distinct in themselves, whilst oth[illegible] necessarily, are somewhat incongruous.

The Registry.—On January 1st, 1876, the [illegible] for receiving applications for the registratio[illegible] Trade Marks was opened at 4, Quality-[illegible] Chancery-lane, under the superintendence [illegible] Commissioners of Patents, Mr. H. Reader La[illegible] the Board of Trade, a gentleman who had [illegible] much commercial experience during his many [illegible] connection with that department, being appo[illegible] Registrar. Some time afterwards, Mr. J. [illegible] Whittle, Barrister-at-Law, was appointed Assi[illegible] Registrar, being subsequently succeeded by [illegible] McCalmont Cairns. The registry is now [illegible] manently established at the Patent-offi[illegible] Southampton-buildings.

Applications during the first year flowed [illegible] rapidly. The number received up to Decemb[illegible] 1876, was 3,698, covering a total of 10,384 [illegible] Of these, 2,204 cotton marks were sent [illegible] Manchester. 56 oppositions were made dur[illegible] first year.

Marks were first placed on the regi[illegible] October. The number of marks registered [illegible] December, 1876, stood at 261, some of whic[illegible] registered in more than one class, the total [illegible] trations attained was 454.

Meanwhile 47 numbers of the official [illegible] known as the *Trade Marks Journal*, ha[illegible] issued. The first number was published o[illegible] 3rd, 1876. The *Journal* specifies the nam[illegible] calling of applicants, the description of [illegible] to which the marks have been or are [illegible] applied, and, in connection with old mar[illegible] length of time during which they have bee[illegible] such information is accompanied in eve[illegible] stance by an illustration of the mark, w[illegible] exception hereafter referred to. During [illegible] 4,031 different marks were advertised, g[illegible] total of 4,874 advertisements, many of the [illegible] being applied for in more than one class.

Particulars of the marks registered are [illegible] in the *Journal*. The first list was given in [illegible] January 3rd, 1877. Every successive num[illegible] contained a list of the marks registered si[illegible] issue of the preceding *Journal*.

During 1877, the second year, the [illegible] of marks tendered for registration was co[illegible] ably less, thus enabling much attention [illegible] devoted to the marks left over during t[illegible] ceding year, the registration of which [illegible] ingly proceeded with rapidity, 4,964 being on the register by the end of that year.

ience brought to bear by this time also
many questions, in regard both to
law, which had to be settled by judicial
registration in connection with certain
marks necessarily had to remain in
nding such decisions in the Courts of
. There were several appeals, and one
en to the House of Lords.
y after the great mass of marks in use
branches of industry had been brought
s to permit of examination, that any
ould be made in connection with what
ed under the term of "private" and
as "common" or "open" marks.
ion is not confined to the cotton trade,
st conspicuously displayed in marks
erein. It extends to other industries,
may be specially mentioned the iron
hich arose the questions settled in
case") and the needle trade.*

The number of marks advertised in 1877 was 7,907, as against 8,753 placed upon the register. Of the latter, of course, a large proportion included marks applied for during 1876.

In 1878, 3,240 marks were advertised, and 3,687 registered. In 1879, 3,198 were advertised, and 3,118 registered, against 2,417 advertised and 2,752 registered during 1880. The total numbers for the five years thus attained are 21,636 marks advertised, and 18,764 registered*.

be made of the following different modes of regis-
representative registration, as in Barrows's case
e, where an essential feature is registered, with an
intimation that this feature is protected in a variety of combinations. Registration with a note appended, limiting registration in some way; re Mitchell (2); re Leonhardt; re Kuhn and Co.; ex parte Barrows; re Jelly, Son, and Jones; re Lysaght; re Rabone; re Farina (3); re Whiteley (all in Sebastian's Digest of Trade Mark Cases); re Sykes (29 W. R.) Registration of essential features only, as in Orr, Ewing v. Registrar of Trade Marks, in House of Lords. The decision of the Court of Appeal seems at variance with this decision when, in re Royal Baking Powder Co., they refused to register the word "Royal," or the words "Royal Baking Powder," without other details, though the word "Royal" was the only feature in the whole label that could be called distinctive, which, in this particular trade, it appeared to be.

* The following is a statement of the Number of Trade Marks Advertised and of the Number Registered in each of the 50 Classes of Goods, respectively, during the five years commencing 1st January, 1876, and ending 31st December, 1880:—

	1876.		1877.		1878.		1879.		1880.		Total.	
	Advertised.	Registered.	Advertised.	Registered.	Advertised.	Registered.	Advertised.	Registered.	Advertised.	Registered.	Advertised.	Registered.
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
....	80	2	106	186	42	56	47	39	37	47	312	280
....	69	3	90	132	47	43	27	24	40	30	273	232
....	273	28	374	456	148	207	126	106	144	184	1,065	931
....	30	3	92	74	39	45	36	36	24	81	221	189
....	520	64	460	659	196	159	168	228	65	115	1,409	1,225
....	161	34	228	269	62	83	40	50	16	18	502	454
....	86	...	140	111	45	72	21	29	14	10	256	222
....	19	...	72	61	29	27	18	14	13	29	151	131
....	21	7	29	30	8	13	11	7	6	7	75	64
....	35	6	35	45	19	22	18	17	18	18	125	108
....	18	4	43	43	18	23	11	15	14	9	104	93
....	221	3	363	457	107	131	51	57	58	80	800	728
....	419	27	586	687	188	185	91	206	156	129	1,440	1,234
....	122	28	98	154	41	43	58	68	33	29	342	312
....	24	4	28	34	11	17	12	11	21	21	96	87
....	57	17	41	61	21	22	24	21	19	19	162	140
....	16	2	31	27	14	11	14	17	10	7	85	64
....	77	4	84	111	27	35	13	16	25	12	226	178
....	29	2	44	52	18	23	6	11	8	7	105	95
....	17	2	41	26	11	30	1	7	2	1	72	66
....	29	1	33	39	11	17	11	13	2	2	88	72
....	9	1	18	18	17	14	4	5	15	9	63	47
....	...	...	365	225	148	238	124	116	196	214	833	793
....	...	...	...	...	52	7	1,030	752	313	588	1,395	1,347
....	...	...	62	81	50	56	40	44	15	22	167	153
....	9	...	86	57	22	52	21	19	16	9	154	137
....	10	...	140	122	28	44	20	14	17	17	215	197
....	3	...	56	35	22	41	16	12	12	12	109	100
....	2	...	23	21	9	9	12	11	5	6	51	47
....	38	...	69	67	45	60	16	20	15	19	183	166
....	12	...	63	57	37	44	16	14	18	18	146	133
....	4	...	98	47	41	72	15	20	22	19	175	158
....	27	...	34	40	24	30	18	16	24	17	127	103
....	16	...	197	156	101	120	62	51	56	60	432	387
....	9	...	87	54	67	79	28	29	17	24	206	186
....	17	4	31	36	18	12	15	18	9	10	90	80
....	44	3	60	77	29	26	15	23	15	16	163	145
....	104	13	206	252	118	125	67	72	77	70	572	512
....	197	27	350	269	133	189	159	86	65	136	904	707
....	16	...	50	45	27	26	18	21	10	15	121	107
....	15	3	34	30	14	12	11	14	7	8	81	67
....	429	70	432	624	241	202	161	179	160	151	1,432	1,226
....	676	81	710	1,073	217	259	131	185	149	132	1,883	1,630
....	131	12	271	215	50	64	29	38	59	41	540	365
....	292	23	538	547	150	209	124	149	155	145	1,259	1,073
....	5	3	2	2	2	2	1	2	2	1	12	10
....	186	4	301	391	108	124	82	85	76	85	765	689
....	158	9	167	239	178	102	51	50	65	64	618	464
....	19	...	33	29	18	18	20	24	8	13	101	84
....	167	15	418	350	172	188	95	117	86	76	987	746
....	4,874	454	7,907	8,753	3,240	3,687	3,198	3,118	2,417	2,752	21,636	18,764

During 1876, there were issued 47 numbers of the *Official Journal*; 76 in 1877; 33 in 1878; 27 in 1879; and 26 in 1880. The total for the five years is 209.

There can be no doubt that registration has had the effect of encouraging the adoption of new trade marks. This is shown by the fact that. whilst in the first six numbers of the *Official Journal* the proportion of old to new marks was 633 to 100, in the last six issued during the year 1880, there were advertised but 91 old marks against 365 new. As a matter of course it may be assumed that the bulk of the old marks, that is those in use at the passing of the Act (August 13, 1875), have been tendered for registration in the five years during which it has been in operation. Under the restrictions prevailing with reference to new marks, it may well be claimed that there is thus every prospect of ample distinctiveness in the trade marks of the future.

OPPOSITIONS.—In all, during the five years, 287 oppositions have been made. Of these, but a small proportion of cases have been carried into Court, a great number having resulted in compromises between the parties concerned, or by the withdrawal of the original applications.

REGISTRATION OF SUBSEQUENT PROPRIETORS.—Under assignment, and by transmission, 135 registrations have been effected during the five years. Some further provision on the subject seems necessary.

I am aware of an instance in which the agent in this country of a Continental manufacturer, under instructions to register a trade mark for his principal, completed the registration in his own name, not omitting, however, to debit the costs to the rightful owner of the mark. Subsequently, on the wrongful registration becoming known, the owner was content with the surrender of the notification of registration previously issued by the registrar, and an assignment of the mark itself. As to the value of an assignment under such circumstances, it is not for me to pronounce, but I venture to doubt whether the registration of what is not lawfully possessed can ever be valid, or any legal assignment of it possible.*

CERTIFICATES OF REGISTRATION.—During the five years, 614 certificates for obtaining registration abroad have been applied for, and 86 certificates for use in legal proceedings. The facilities accorded in procuring foreign registrations have been found of much value in all instances, whilst in some countries, as is well known, registration of British trade marks could not have been otherwise obtained.

CERTIFICATES OF REFUSAL.—Up to December 31st last, 212 such certificates had been issued. Athough this number is comparatively small, it must be admitted that the value of the certificate to the owners of the marks has in most instances fully warranted the providing for such certificates in the Amendment Act of 1876. I am not aware whether in foreign countries, where the certificate from the registry here is a *sine quâ non* to obtain registration by British manufacturers, the certificate of refusal is equally recognised. Certainly it should be so. The certificate of refus were, a recognition of the user of the the official statement of the fact that although possibly a valid one, is not registration here under the Act.

SEARCHES.—The total number of se inspections at the registry during the was 4,801.

RECTIFICATION OF REGISTER.—In all, tifications had been effected prior to De last. This is not astonishing, for when and cost of an application to the Higl considered, it may be well assumed effort is made to avoid recourse to such even when involving merely a cor The registrar has the power at during application, both before and advertising of a mark, to permit any but once placed upon the register, the wholly out of his control and into Court. That this should be so in re essential and distinctive features of the is undoubtedly reasonable; but that t should not be empowered to make a alteration in a registered mark which in such as address, &c., can scarcely be Under proper restrictions and the proper fees no difficulty should be pl way of a registered owner making alterations as may be required from t upon the register. This is a question to be dealt with under a new rule, ture respectfully to submit it to th tion of the Commissioners. That the of the Chancery Division of the Hi Justice should have to be brougl and its ponderous machinery set in n mere trifling alteration in an old lal register seems monstrous. In one recent date, the registered owner of desirous of striking out in one the w factory," and to reduce the size which his address appeared, and pu brackets, did actually apply to the order. Certainly, under the same moti fied the register by striking out the pared by" from a second label, a type and character of the address likewise obtaining authority to plac brackets; and similarly to get rid c "manufactory" and vary the addre label, all for one set of costs. The ob an application, doubtless, was to obtai bearing the labels in the amended fo foreign registrations. The applicant, of course, when registering abroad, to protect his labels in the form in whi now used in the country in which re sought. If he obtained the certificat original registration, the representat certificates would not correspond witl sentations tendered for the foreign r The application would be refused; and i necessary as a preliminary step to register here.

If a trade mark is incorrectly reg person who is aggrieved can apply register rectified, and the mark whole or in part, or a note append the registration in some way. The

* See *ex parte* Lawrence, *re* Bust, and *re* Farina. 29 W. R.

either on the ground that the
›erty of the applicant, or that it is
ty, and should not be registered
illustration of this class of cases
'ax case. Messrs. Hyde registered
ınk of England" as applied to
hereupon other makers of wax
Court to rectify the register, by
ırs. Hyde's registration. They
f the words "Bank of England"
trade for upwards of forty years,
ınce the Master of the Rolls ordered
to be cancelled. In giving judg-

nt on every one who disputes the title
apply as speedily as possible to remove
he register. Those who register a
ey are not entitled, do so at their own
They must satisfy themselves before
it is a mark to which they are entitled,
any reason whatever for drawing any
n one title and another. If a man
has a right to register, and if he has
not to attempt it. As a general rule,
ıtood that every man registers at his

rectification has been summarised
ırn.*

stances applications to the Court
have been necessitated by the
er having omitted to include the
ther members of the firm in the
ıtion, registration then being
ıame of the applying partner as
alone in the name of a firm. The
ourt to direct rectification in such
require enlargement.

ᴇs. — The new rule made on
78, providing for the cancellation
the register by the proprietor,
d in only eleven instances, is
. Its utility has been found in
ıin my own knowledge, in facili-
ıg on the register of the rightful
eign trade mark which had been
egistered in the name of their
The cancellation, in the first in-
sequent re-registration, have pre-
mode of dealing with what other-
e involved an application to the
complicated procedure. Similarly,
specifying ownership, or in the
ıe trade mark, or the term of user,
ıally been committed in the original
ler this rule applicants who do not
the advantages of the earlier date
of registration can cancel and re-register at later date in a corrected form.

FINANCE.—The total revenue received at the registry in respect of fees, certificates, searches, &c., for the five years amounts to nearly £30,000.* The cost of conducting the office has been considerably less. Judged by the practical value of the work done, this is not material. It is, however, a matter for consideration whether a department of this character should not be conducted wholly irrespective of the question of profit or loss. The fees fixed are moderate, and when it is borne in mind that no further revenue in respect of marks registered can be anticipated until the expiry of the fourteen years over which registration extends, a credit has to be taken from the funds meanwhile as it were accumulated, as against the cost of conducting the registry during so many subsequent years. In this manner it may perhaps be assumed that on balance at the expiry of the first fourteen years the registry will be found to have just paid its way as a department. This by many will be viewed with far more satisfaction than are the constantly accumulating profits of the Patent-office.

DEFINITIONS OF TRADE MARKS.—All laws on the subject of trade marks and systems devised for their registration are founded on the ground common to all, viz., efficacious and economical protection.

In whatever country, therefore, trade marks are made the subject of legislative enactment, the definition of that which is to be protected—the trade mark itself—is of primary importance.

The initial difficulties which must encounter any attempt to establish an international trade mark law, will be found in the fact that each country has defined a trade mark according to its own prevalent ideas of what it should be, and not with the view of finding some definition which would be common to all countries.

For instance, in England the *fac-simile* of a signature is recognised as a trade mark. This is not so in America, unless the autograph has something to distinguish it from other autographs of persons similarly named. The pressing importance of unifying, at the earliest possible moment, the definition of a trade mark, was somewhat fully

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ıcery Division is satisfied that the applicant
r the time being entitled to the exclusive use
accordance with law, and that the trade
the definition of sect. 10 of the Act of 1875,
to justitiæ to rectify the register, just as it
t of 1875 have been bound *ex debito justitiæ*
o prevent any one infringing a trade mark
perty. The burden of proof lies upon the
ıpplication to amend the register, but if he
roof as would in the opinion of the Court
ınction, I do not think that the words of the
fied of the justice of the case,' can or ought
neaning to give the Court a discretion to
nature of the trade mark is such as to make
e should exercise the right of property which
ly has."

*ACCOUNT OF FEES FROM 1ST JAN., 1876, TO 1ST DEC., 1880.

	Number.		Amount. £	s	d.
Applications	11,749	...	16,607	13	4
Advertisement Fees (additional space in *Journal*)	2,229	...	621	15	0
Oppositions	287	...	606	0	0
Registrations	14,676	...	10,970	6	4
Duplicates of Notification of Registration	112	...	11	9	0
Certificates of Preliminary Procedure	15	...	3	15	0
Certificates to obtain Registration Abroad	614	...	161	13	0
Certificates for Use in Legal Proceedings	86	...	88	3	0
Certificates of Refusal	212	...	184	0	0
Registrations of subsequent Proprietors	235	...	127	9	0
Folios of Office Copies of Documents	3,039	...	25	6	6
Searches and Inspections	4,801	...	241	0	7
Rectification of Register	47	...	25	0	0
Cancelling of Entries on Register	11	...	2	15	0
Altering Address on Register	4	...	1	0	0
Fees on Settling Special Cases by Registrar	4	...	4	0	0
			£29,634	5	9

dwelt upon in a paper on the subject, which, conjointly with Mr. Israel Davis, M.A., Barrister-at-Law, I had the honour to contribute to the International Congress on Industrial Property, held at Paris during the Exhibition of 1878.*

It is not my intention here to pursue this subject further. I will simply remark that it would be well if the manufacturers and merchants of England would unceasingly exert themselves to bring about an international trade mark law. No country would be more benefited by such a law than our own.

For the purposes of the Trade Marks Registration Acts, the definition of a trade mark became necessary, and, having regard to the preconceived notion that a trade mark consists in any name or device adopted to designate goods, its definition must have been found exceedingly difficult; and it may be mentioned that practice is considered by many to have shown that the definition adopted might have been improved upon.

Certain it is that much of the litigation of the last five years about trade marks has arisen out of this definition, by reason of its restrictive character, and the distinction it creates between old and new marks—old marks being all those in use prior to 13th August, 1875 (the date of the passing of the Act), and new marks all those not used prior to that date.

Prior to the new Acts, the common law recognised as a trade mark, a signature, a figure, a fancy name, or a letter, or a combination of letters or words, or a device. Under the Acts, letters, words, figures, or combinations of letters, words, or figures are only recognised as capable of registration when in combination with a device, mark, heading, label, or ticket.

Let me give some instances bearing upon, and illustrative of, the subject.

Word Marks and Decisions relating thereto.—Soon after the Act came into operation, an application was made to register the fancy word, "Aeilyton," which had not been used as a trade mark before the passing of the Act. The Master of the Rolls refused to order it to be registered, holding that only those words which had been used before the passing of the Act as trade marks could be registered; the reason assigned being that, under the definition of a trade mark given in the Act, a new word could not rightly be claimed. The practical result of this decision was to exclude from registration all fancy words invented and first used after the 13th August, 1875. So, while "Anatolia" as to liquorice; "Eureka" as to shirts; "Glenfield" as to starch, and a number of other such words, are all trade marks, it is not now competent for any person to create a new trade mark of any such fancy word. As fancy names are among the best remembered of trade marks, the result is to give to articles so named, and established in use before 1875, an important advantage, and to check the continuation of a system which, in the past, has been proved to possess great commercial value.

Another important restriction on the definition of trade marks was arrived at by the decision, on the application of Messrs. Mitchell, the pen manufacturers, who had used the le alphabet from A to W, as descriptive of qualities of the pens made by them, were known to the trade and the "Mitchell's A," "Mitchell's J," &c X., after defining what, for the p the Act, is regarded as a trade m the power to add thereto (that is, to mark), "any letters, words, or figure bination of letters, words, or figures." is used throughout. Messrs. Mitchell register all these letter marks sepa registrar refused, and the Court uph fusal, on the ground that, as the defi trade mark in the Act was in the plural, letters or combination of letters, a sing not come within the definition, and such a trade mark as could be registere Act. This decision has had the ef cluding from registration all sin and numbers, unless in combin something else. How far this is go be doubtful, as another learned ju and on this point his decision has n versed by the Court of Appeal—tha Act all marks that the Court would ha by injunction before the passing of the A be registered under the Act, the definiti mark given in the Act applying to new This opinion is based on the idea tha of the Act was to protect property, marks used before 1875 the owner had and that that property should be prot Act, which could not interfere with v that, therefore, the definition of a given by the Act only applied to new Legislature having the right to say t its protection to things in which no p perty already existed, that its own ter observed as a condition of giving tha Although the case in which Vice-Chan lays down these doctrines was cited i ment in Mitchell's case, the Court accept the doctrine, but decided that poses of registration, the definition applied to all marks, new or old.

In connection with numbers, I am any test cases having arisen, but tha possible for a paper manufacturer, number happens to be 10 or 11, to number as his trade mark, and that r the owner of mill No. 8 or No. 9 shou seems anomalous. Paper manufacture consider their mill numbers as their and many are so registered in Cla separately as mere numbers, others registered labels, or ream wrappers paper trade.

In Class 3 has been registered a ma of the words "Trade Mark" with th figure "A 1" in combination. The Mark" cannot be claimed as special being only permissively placed upon in connection with old marks. The "A 1" only comprises a single letter figure—a hybrid plural. This restric plural would certainly appear to ne sideration when the matter again con Legislature. May it not be regarded

* "Congrès International de la Propriété Industrielle," No. 24, page 635. Paris: Imprimérie Nationale, 1879.

the Act of 1875? No reason can be traced, so as I am aware, for placing owners of marks sisting of single letters, or single figures, or letter and one figure in combination, under so cial a disadvantage.

a reply to remonstrances made on behalf of an licant for the registration of an old word mark ich had been refused, the registrar some time e, with much justice, and, as it must be added, with very commendable frankness, wrote, ; "it was only by a very gradual process that Commissioners were able to settle the principles which the distinctiveness of marks consisting words only could be determined." In the early s of the work of the office, many word marks entered upon the register, applications for , if tendered at a later date, would not have entertained. For instance, in Class 3 (mostly ibed as medicines) there are upon the register word trade marks as "Infant's Relief," mily Salve," "Mother's Hope," "Bosom d," and many others of a like character. Chancellor Hall, in December, 1879, granted junction in respect of "Family Salve" as gistered trade mark of the owner, infringed e who had been in his employ as an assistant. e last, Vice-Chancellor Bacon ordered the ation of the words "Kitchen Crystal Soap" completed, considering them as "special and tive," it being proved in evidence that these had been used as a trade mark for twelve years. gistrar had declined to register these words he application of the owner of the mark, adelphia manufacturer. The same words, ly enough, had already previously been red, conjointly with a monogram, for a soap manufacturer claiming a user since To the parties concerned the later prac- dopted at the registry may appear as ing injuriously as against the later appli- It is not really so, however, for it was o all owners of old marks in use prior to ugust, 1875, to forthwith lodge their applica- n 1st January, 1876, when the registry was l. Having neglected to do so, it is by their efault that the opportunity has been lost. ration, conjointly with signature or device, w to be resorted to in connection with such rks equally as with new ones. It only re- to express the hope that, should future tion provide for the rehabilitation of the of word marks, all meanwhile registered the present system may be recognised retro- ely, or their re-registration as words alone vided for.

class of marks has been still further limited e decisions that have been given on the themselves. To constitute a trade mark, it en held that the mark must not bear any n to the subject matter in respect of which plied, and this whatever period of user may longed to it. Thus, "Nourishing Stout" ld not to be a trade mark, because merely tive of the article. But a word such as stura," when applied to bitters, being not tive but distinctive, was held to be a trade the test in each case being, "Is the word tive or merely descriptive?" If distinctive, owever absurd or far-fetched (and the o the better), it is a trade mark, and entitled to protection; if descriptive, it is under no circumstances to be registered. This point was dealt with in the case of Lamplough's Pyretic Saline. Mr. Lamplough claimed the use of the word "Pyretic," but the Master of the Rolls, in the first instance, and the Court of Appeal afterwards, held that there could be no property in an adjective simply descriptive of the quality of the goods sold. In another case a contest arose between the words "Valvoleum" and "Valvoline"; both fancy words, both invented to describe the particular article; but each as a trade mark used in combination with a different device; here it was held that no property existed in either word, as both were only another form of stating that the substance was valve oil.

The effect of the decisions having, therefore, been to limit materially the number of fancy words that could be registered, a further point arose on the use of names as trade marks in cases where the name had been used by various manufacturers, as applied to certain classes of goods, such as the word "Berlin" in connection with wools, "Axminster" for carpets. This point was settled in the case of the word "Alloa," as applied to yarns. An application was made to register the word "Alloa" as a trade mark, by a manufacturer who carried on business at Alloa, and manufactured a species of yarn known in the trade by the name "Alloa." The registrar refused to register this word, and his refusal was upheld on the ground that although the word "Alloa" might have been a trade mark if used to denote the goods of one manufacturer, yet, as it had come to designate not a particular maker's goods, but a special kind of goods made by different makers, it had ceased to be distinctive of the maker, had become descriptive of the material, and so could not be a trade mark.

So great a hardship has the public found the restrictive definition of a trade mark, that every conceivable device is resorted to with the view of obtaining the much-coveted right to use, and if possible to protect, fancy names as trade marks.

A vast number of word registrations have been effected in many classes, the system most frequently adopted being to combine the desired word with the signature of the applicant. In use, such words sometimes appear conjointly with the signature, then, of course, corresponding with the full description on the register; but, in many instances, the fancy word is all that it is desired to use and claim, and the signature is omitted.

The question arises, "To what extent are fancy words protected when so used alone?" Upon this point the decisions of the Court will be most anxiously awaited when the question is tried. The word is on the register; fees in respect of it have been paid; the Act has allowed it to be added to the essential portion of the trade mark, viz., the *fac-simile* signature, but has not distinctly specified whether in being so added it acquires the same protection as the signature or as any trade mark distinctive and complete in itself; whether, in fact, it is at all such a portion of the trade mark as can be protected. Against this, it must be noted that, under the Act, the signature is made the essential particular, the addition of a word or combination of words being merely permissive. The question comes to be whether the registration protects the

combination, or only the essential feature. This has to be answered in all cases.

The importance of the interests involved cannot be overrated, and of this the columns of the newspapers afford ample evidence. For instance, take one industry alone, that of the new temperance drinks. In connection with these it is of paramount importance to obtain a distinctive name, and to identify the same with the particular article to which such name has been first applied. Although some of these drinks are patented, it is only under a distinctive name that they can be identified by the public.

Does registration of the name of a particular drink, in combination either with a device or the signature of a firm, give the owner of that drink a right to restrain another who may sell a beverage under that name manufactured by himself, the beverage being distinct from that originally patented? Take, for instance, the words "Hedozone" and "Zoedone," which are not old trade marks. It is, I apprehend, sufficiently significant of the necessity which exists for further legislation on the subject of trade marks, that a doubt on a question of this nature, in which capital to the extent of, perhaps, millions of pounds sterling is involved, should exist. If the Legislature did not intend to accord protection to the letters, words, and combinations of letters which may be registered as ancillary to the essential portions of the trade marks, is not the Legislature misleading the public, and, in fact, permitting registration fees to be paid in respect of a protection which is not given?*

The statistics on this subject show the value which the public attach to the privilege of being able to acquire rights in words. Selecting seven classes in which word marks are most prevalent, I find that out of a total of 5,573 marks applied for in such classes, as large a proportion as 1,336 consist of word marks.† If in the particular industries comprised in these classes word marks have in the past proved the most suitable, why should the Registration Act incidentally hamper such trades in the future by restricting them in the use of such marks? The introducer of a new brand of iron, &c. is at a disadvantage since August 13th, 1875, as compared with what was open to him at any preceding time.

Words are registered, in combination either with signatures or devices, in many classes. Of such registrations there are but very few indeed in which any value is attached by the owners to the device, or the *fac-simile* signature, registered in combination with the word. The registration of the signatu device becomes, in almost every instanc subterfuge, and various manœuvres ar to for obtaining this much desired, but tionable, privilege of placing fancy wo register.

The penalties upon imitating signatu serious, that in but rare instances are imi enough to indulge in the luxury of forg

In the course of my investigations, I across a number of amusing instances, manufacturers have resorted to proceedi have the appearance of constituting of the Act, with a view to secure an exc to the use of a series of words and fancy varying their signature with each. A si any particular form is only accepted at once, but may again become eligible by changing the form of any of the capital adding or omitting a flourish beneath ture.

In this manner a firm consisting of ners—Brown, Jones, and Robinson— right of registering one fancy word i tion with the ordinary trading *fac-sim* ship signature of each partner, thus eff word registrations. Beyond this, ea by merely varying his signature, c another word, the firm acquiring thre registrations. Again varying the signa instance, by introducing printing let capitals of the names or otherwise, a bination is created, and three more f placed upon the register. The firm can obtain nine such registrations, a that their ingenuity be equal to their f sities, why should they not be able doing so almost *ad infinitum?*

In another instance, an individual tra very usual in business, with the additi registers in the first instance a fancy w bination with his ordinary *fac-simil* "John Robinson." Introducing a se term in his business, he registers this class as the first, in combination with t signature, "John Robinson & Co.;" in stance he utilises the signature, "J. and, in a fourth, "J. Robinson & Co." he will doubtless take "John Robins pany;" for a sixth he will still have posal "John Robinson & Compy.;" case of necessity, "J. Robinson & Co seventh; backed up, with further va "and" in full. An individual wit Christian name is, in these instances disadvantage, as compared with those a series, every additional Christian na ting the double combinations of utilisi in full, and, under its initial, for an pair of registrations.

It is of the utmost importance tha status of this class of marks, forming ant a proportion of the new marks p the register within the five years unde should be established. If the regist good, no doubt should attach to them. bad, the register should be purged of no more be added.

A friend of no mean authority on of trade marks remarked the other d

* The following questions have been suggested by a member of the bar who has given much attention to this subject:—"Is the drink patented or not?" "If not, why may not every one make it; and if one makes it, by what name is he to call it unless by that which is the true and known one?" "If he invents a new name he describes the article as different from the old one, and misleads the public?"

† Class.	Total Marks Advertised.	Word Marks.
3	1,065	175
5	1,409	515
6	502	192
18	226	92
38	572	126
44	540	57
49	1,259	179
	5,573	1,336

purposes of commerce, he considered a trade consisting of a fancy name of far greater than any device. Without altogether agree- rith my friend's opinion, I am certain that a proportion of those interested in trade marks his view, although many urge that the best is to register a device, *e.g.*, an animal, as a and to get the article known to the public iger" ale, &c.

gistration is a boon for which the manufac- s of this country had continuously asked for ards of twenty years. Lord Cairns, as the r of the Registration Act, undoubtedly in- d that it should prove of the utmost use, at whilst giving with one hand what was with the other new restrictions on com- hould be created.

e certainly never heard of any reasons which ed to me to be valid or of weight, why d and fancy word should not be allowed to ute a trade mark. No confusion can prevail. ne desirous of using a name in connection particular class of goods, can always ascer- whether such name is already on the register.

TTON MARKS AND DECISIONS RELATING TO.—From the beginning, it was foreseen ry special difficulties would be found to pre- the preliminary investigation of the claims gistration of cotton marks.

Commissioners of Patents deemed it advis- hat a duty of so technical a nature should to t extent be carried out by gentlemen them- interested in the trade, and likewise able to to bear local and general experience. In this a committee of experts acquainted with the of the cotton trade was, with the co-opera- f the Chamber of Commerce at Manchester, ated by the Commissioners of Patents.*

this committee was entrusted the duty of ing to the Commissioners upon the marks d as in use as private property, and so the meaning of the Act entitled to regis- , as distinguished from what were to be d as open marks outside the scope of the The investigation involved was of a most s character, and necessitated the deferring of ming into full operation of the Act of 1875, led for one year under the Amendment Act 76, and subsequently from time to time r prolonged, by successive Orders in Council t July, 1879.†

Manchester committee commenced its labours tober, 1876, having its office at 48, Royal- nge, Manchester, of which Mr. Joseph Fry was nted keeper. The committee, in the first in- , proceeded with the examination of the 41,712 applied for in Class 24, "Cotton Piece Goods." f their early decisions in regard to combina- marks being questioned, the examination of l marks could not be completed within the ibed date, and this, in a measure, necessi- the extension of time referred to above.

At June 30th, 1877, the committee had examined 33,681 marks, leaving 8,031 to be dealt with later.

The number to be examined in the first instance would have been considerably greater but for the United Bleachers' Assosciation having, at an early stage, consented to the withdrawal of the whole of their marks, to the number of upwards of 16,000. These were placed in the category of open marks, thus saving much labour and possibly litigation.

The committee in all held 145 meetings prior to completing the investigation of the old marks.

The total number of marks considered was 44,158, composed thus:—Class 23 (cotton yarn and sewing cotton), 2,490; Class 24 (cotton piece goods), 41,455; Class 25 (other cotton goods), 213.

Of this extraordinary number the remarkably small proportion in the respective three classes passed as capable of registration under the Act was 938, 3,413, and 187, respectively; in all, 4,538 out of 44,158—just over 10 per cent.

Meanwhile the Lord Chancellor had divided Class 23 into two divisions, thus providing for a difficulty which had presented itself in regard to cotton yarn and sewing cotton in consequence of the original classification not having divided cotton yarns from sewing cottons.

Similarly, under a special rule, dated February 20th, 1877, it was provided that cotton marks need not be advertised with illustrations in the *Official Journal*, but that the marks should be on view simultaneously at the registry in London and at the Manchester office for a period of three weeks after they had been advertised in the *Official Journal*, under their mere official numbers, with particulars of ownership and date of user. This period was by some deemed to be very short for opposition to be made, particularly as compared with the minimum interval of three months provided in connection with marks advertised with representations. No difficulty or injustice has, however, been traced to have arisen under this head, no doubt from the fact that the utmost vigilance was exercised by the Manchester committee in the first instance in approving the applications for the marks, which the registry subsequently proceeded to advertise.

The first marks in Class 23 passed into the stage of advertising were announced in *Journal* No. 107 (September 5, 1877); the first in Class 24 in *Journal* No. 152 (November 27, 1878); and the first in Class 25 in *Journal* No. 113 (October 17, 1877).

Registration followed in most instances soon after the expiry of the three weeks' interval, the references to the original representations at the registry and the Manchester office meanwhile made being comparatively few.

The Manchester committee of experts, having divided all the cotton marks into two great classes —the "A" list comprising those in which a distinct private right existed, and the "B" list those that, having been used by more than three persons, had lost their distinctive character and become common or open marks—many complaints arose on the part of persons who were placed on the "B" list, and who alleged that their marks were not public, but private property.

The dispute became complicated by questions as to what was the exact position occupied by the Manchester committee. It was contended by some

* *chester Cotton Committee.*—Edmund Ashworth, Esq., President of the Chamber of Commerce, Manchester; A. Bernus, Esq., G. Carlisle, Esq., James Chapman, Esq., W. F. Danson, Davies, Esq., George R. Davies, Esq., S. A. Fulda, Esq., hmidt, Esq., C. P. Henderson, jun., Esq., A. J. Hunter, J. Leppoc, Esq., G. Lord, Esq., J. W. D. Mather, Esq., ston Potter, Esq., E. Reiss, Esq., S. P. Schillizzi, Esq., nthal, Esq., E. H. Sykes, Esq., A. Wallace, Esq.

† ers in Council, December 12, 1877; June 29, 1878; r 27, 1878; and May 17, 1879.

applicants that they were only a number of persons who, having a special knowledge of the trade and its marks, were deputed to arrange and classify such marks. Others claimed that in effect the committee was a judicial tribunal—a tribunal of commerce—and that its finding on matters of fact could not be questioned or interfered with, unless it was shown that the committee had acted illegally or wrongfully. Vice-Chancellor Hall adopted the first view, and held that he was at liberty to disregard the decision of the committee, to look at the evidence for himself, and to draw his own conclusions. The Court of Appeal took a different view, holding that the decision of the committee was *primâ facie* conclusive. The House of Lords, on appeal, reversed the decision of the Court of Appeal, and affirmed the judgment of the Vice-Chancellor, thus holding that no judicial character whatever belonged to the committee. Lord Blackburn's judgment fully summarises the position.*

The Courts being at liberty to go behind the decision of the committee of experts, several cases have since arisen in which their decisions have been questioned, and questioned successfully.† Each of the cases, to a great extent, involves questions not of law, but of fact, and depends on the facts peculiar to it. The practical result of the cases is that the decision of the committee is only taken as shifting the onus of proof, and throwing on the person who applies for the order to register the onus of proving his title to the mark.

Interesting and important questions have arisen, questions which cannot be said to be in any way settled. In a recent case, a mark had been placed on the "B" list that had been used for upwards of fifty years by the particular firm who claimed it, and to their knowledge had been used by no one else. But it appeared that various bleachers to whom the manufacturers brought their goods to be bleached were accustomed to ask their customers what kind of finish they would like placed on their goods; did they want "X's" finish, or Y's," or "Z's"? These bleachers kept books containing all the marks of the chief manufacturers, any which they would put, if asked, on goods brought them to be bleached. Could this fraudulent use by the bleacher deprive the manufacturer of his
property in the mark, so as to make th
an open one? It would seem that it cou
the manufacturer, it is said, ought t
known, and would be taken to have
that these marks were being so used.
would it make any difference if the mark h
affixed by the bleacher for export only, a
never been used in this kingdom, but only
This point seems still to be undecided. It
to be more a question of fact than
whether the manufacturers had the m
knowing, and could they be reasonably
have known, if they had used due c
vigilance? If so, their right would b
In some cases the matter was still furth
plicated by the fact that the bleachers
united together as members of an associ
that the association included the bleach
bleached for each manufacturer. Did th
the bleacher being in effect the servan
manufacturer, and being a member of, and
what was done by, the association, affect th
the manufacturer, with notice, so as t
acquiescence to him? It would seem
been held that the manufacturer lost h
This extension of the doctrine of impl
to trade marks, which has had the
depriving the owner of valuable mar
property, and giving the right to use th
world, seems unjust. The result of its a
has been yet worse; for owners of ma
titles, if the Act had not been passed, w
been undisputed both here and abroad, h
themselves deprived of valuable propert
they have not hunted up and prosecuted
cases of infringement. Had not the
passed they would probably in all cases
able to obtain injunctions to protect
perty. Now, with the decision of the M
committee against them, and that dec
ported by the public purse, with the aid
officers of the Crown, their chance is sm
is still worse, the Manchester committ
any person to send in any marks h
they took no evidence; they required
they acted on the representations sent
so that infringers, by merely sendin
infringements, not only deprived the
their exclusive rights to their marks
succeeded in obtaining a legal right
for the future; for if the mark on
common property, the owner's right w
ever. Nor did the abuse stop here;
case a bleacher had the assurance to a
allowed to register a manufacturer's m
was allowed to do so. Thus, by me
Act passed for the protection of proper
prevention of fraud, the pirate is not on
to escape from being punished for his p
to acquire an exclusive right in the p
has pirated.

This is not the worst aspect. The stan
is occasionally seen of the Attorney-Gen
cost of the public, acting as the champ
pirate. The Commissioners of Patent
cases, say they are bound to uphold th
of the Manchester committee, and, for th
to oppose any application the manufac
make to have his property restored t
applying to the Court to enforce the r

* "It would not be usual, or according to the usual principles of justice, that these persons (the committee) should determine upon a question of property without a hearing. The fact, therefore, that the proceedings of this committee are by rules entirely *ex parte*, in my own opinion, goes very far indeed to show that the opinions of the committee were not meant to be final, even to the limited extent the Court of Appeal thought them binding. But I think it rests with the registrar of trade marks to show that these rules are so framed as to make the decision binding, and I find no words to express that the appeal, especially reserved to the Court by the 62nd rule, shall be clogged by anything more than that weight which common sense requires should be given to the opinion of such a body. If the appellants took proceedings to prevent any one from infringing their firm's trade mark, they would have to make such a case as in the opinion of the Court would outweigh the opinion of the committee. I cannot but think that if they make such a case now, they are entitled to an order."

† One of these cases was Hoyle and Sons, Limited, where the British and American flags, with the words "Union is Strength," were ordered to be registered. Another was Dickinson, Ackroyd, & Co.: a Chinese figure holding a scroll bearing Chinese characters was regarded by the committee as an ordinary mandarin, although claimed as "Ka Kum," a Chinese philosopher. Vice-Chancellor Hall ordered registration. The same judge ordered registration in Dugdale's case of a phœnix and demi-griffon, and in Siltzer's case of a jockey riding, both of which had been placed by the *committee in Class "B."*

mark, notwithstanding he is placed on the list. If this application was allowed on a *facie* case being made out, the applicant be brought face to face with his opponent, would oppose the registration, and the case be tried on its merits; but this is not done. egistrar opposes the application to proceed the registration. Evidence is collected at public expense, counsel are retained by the rar at the public expense on behalf of the , and the edifying spectacle is seen of -protected fraud contending with the honest r. Moreover, the money used by the registrar litigation is the money paid by the fair trader ster his mark; and this money is spent in g the battle of the unfair trader. Surely carrying the *sic vos non vobis* doctrine to its limit.

important question arises out of these dis- Does the old maxim, *Quod ab initio vitiosum modo convalescere potest*, apply to trade ? Does fraud give any rights? Strangely it would seem that here fraud, if it does not ghts to the wrong-doer, so as to enable him to red on the register as the owner of a pirated (a point upon which, so far, there is no deci- yet gives the pirate the right to keep the off the register. This has been the practice, seems hard to believe it to be good law.

re leaving the legal side of the subject, is one point to which attention should be d, as it is one of considerable practical hard- he important question of costs. It has been l that the Court has no power to order the costs of the preliminary proceedings n any two parties before the registrar, pre- o the case being set down for hearing, to be y the unsuccessful litigant, or to order the ar to pay costs if it turn out that his opposi- either wrong in law or vexatious in fact, the being the peculiar wording of the Act and n the subject of costs. As to private liti- it is only right that all the costs the suc- party is put to should be paid by the essful, as in ordinary cases, for otherwise ouragement is given to frivolous litigants ding up to the point where no risk of costs rred. As to the registrar; it is only fair s the Crown now both gives and receives this rule should be extended to trade mark ion, especially when it is borne in mind that ut of the fees paid by applicants for regis- that the registrar is enabled to find the or litigation.*

DLE LABELS.—With needle labels difficulties r to those found in respect of the old cotton prevailed.

rtain number of gentlemen in the trade were ingly invited by the Commissioners of ts to constitute themselves a Redditch Committee.†

marks submitted for consideration attained of 2,425, of which, upon investigation, only 677 were passed as private marks, the remaining 1,748 being regarded as "open" or "common" marks.

SHEFFIELD MARKS.—The Cutlers' Company of Sheffield, under Section IX. of the Act, and under Rules 46 to 56, have their rights reserved, as was provided under the Merchandise Marks Act, 1862. The registry was to be provided in due course with copies of all Sheffield corporate marks, and the Cutlers' Company, on the other hand, to receive from the registrar copies of all marks tendered in respect of manufactures corresponding with those included in Section II. of the Cutlers' Company's Act, 1860. No new corporate mark can be granted at Sheffield, nor any cutlery mark registered here without mutual concurrence of the registrar and the company. Comparatively but a small amount of litigation has arisen in connection with this class of marks. Registration on the part of Sheffield owners being optional, a number remain unregistered in London.

COLOUR.—The Act defines in precise terms what is to be deemed a trade mark. It is silent as to colour, design, outline, or form. Whilst open to use in all colours, and registered in black and white only, the representations lodged with the application can present the particular colour or combination of colours used in trade, thus permanently recording them. In some instances the identity of a mark always used and known under some particular colour (such as Bass' red triangle) is entirely lost when presented in black and white, as printed in the *Journal*. Notwithstanding this, it may justly be urged that the owner is actually better protected by registration without reference to colour. Registered in no colour, he is in fact registered in all colours, whereas if registered in one and only so protected, other colours might be claimed by future applicants. Cotton marks are, in fact, registered in colours as used, the registration being by deposit, and colour in their case becoming an element in infringement.*

SIMILARITY OF MARKS.—Some learned judges seem to consider that, in the case of a contest between two persons as to similarity of trade marks, the Court is bound to regard questions of colour and size, though the registrar disregards these points, as colour is not protected by the Act, and there are no restrictions as to the size of marks. It is said, on the one hand, the Act contains nothing about form or outline; the mischief to be guarded against is the mischief to be done to one person by another in the course of trade, and in the use of these marks in trade. It would narrow the construction of the Act to say that the Court is only to look at the mark as printed in the advertisements, not to look at the mark as it will be used in the course of trade. Against this it is said, if the mark is fairly printed—printed as advertised—it will not deceive. If, however, it is used otherwise, printed in such a way as not to bring out its distinctive features, that would not be a fair printing; that use would not be a fair use. It would not be the use of the design registered, but the use of something else, not the distinctive mark proposed to be registered. In considering the point

* Rotherham the applicant was put to the costs of a trial appeal, although he succeeded in both instances.

† *itch Needle Committee.*—J. F. Milward, Esq. (Chairman), Avery, Esq., W. H. English, Esq., Thomas H. Harper, B. James, Esq., Walter Lewis, Esq., Joseph Mogg, Esq., gers, Esq., Henry Thomas, Esq., G. F. Townsend, Esq., mer, Esq.

* Judgment of the Master of the Rolls in re Robinson 29, W. R. 31.

if registration should be allowed, the Court should not consider whether, by a dishonest use or dishonest printing, the mark could be made such as to deceive, but whether, assuming it was printed and used with the distinctive design still kept up, it is calculated to deceive from its similarity to another mark already registered.

If this latter view, which is that of Lord Justice Cotton, is the true exposition of the law, a very large number of marks that have been refused registration would still be entitled to claim it. But it opens a door to fraud, which would be certainly used by the dishonest trader; and, as the law now stands, facilities for dishonesty are already too plentiful.

The registration of a triangle containing the representation of a church was successfully opposed, it being held that whilst distinct when presented in black and white, the triangle containing the church could in subsequent use be coloured red, and the church thus be so much obscured as to render the mark similar to that of Messrs. Bass. The expression "calculated to deceive," should, it was laid down, always be interpreted in its broadest signification, so as to discourage the evil of imitation and to facilitate remedy.

Another class of cases arose, where two or more persons, in ignorance of the use by each other, had both used the same trade mark for goods in the same class. Could each be registered, or did the use by two persons deprive the mark of its distinctive character, so as to make it incapable of registration? On the one hand, it was urged that as each had used the mark independently of the other, each had acquired a property in it. On the other hand, it was argued that the use by more than one person had deprived the mark of its essential character of distinctiveness, and so it had ceased to be a trade mark. A compromise resulted, the Commissioners of Patents deciding that in respect of the same mark in the same class, three persons might be registered.* If more than three were proved to have used it, then no one could be registered, as the mark had lost its character of distinctiveness, and ceased to be a trade mark. The applications of this ruling have already been numerous, and if it be possible to take advantage of it to the full extent in the fifty classes, there is the chance of some favourite old mark appearing on the register one hundred and fifty times.

As a result of the comprehensive list of manufactures included in some of the classes, it frequently happens that two or three persons desire the use of the same mark in connection with goods wholly dissimilar, but included in the same class. In such cases I think it might well be left to the registrar, with the mutual concurrence of the persons desiring to use the same mark, to permit them to be entered upon the register, each restricted to his own special manufactures. The following could not, I think, ever come into collision — Patent fuel with beer and wine finings; knapsacks with wooden tops for bottles; hair plaits with straws for sherry cobblers; dog whistles with incubating machines; blind cord with sea water for bathing; m boxes with artificial flowers; mouse traps rolling pins with bridges and summer h tarpaulin with dram flasks, and so on. these, with a multitude of others, are compri under "Miscellaneous" in Class 50.

The registration in the adjoining class (49) of any mark in respect of billiard tables preclude the use of a similar mark for fi nets. These, again, could never come collision. Is it desirable to extend to al classes the system of subdivision as adopted Class 23?

Antiquity of Marks.—Of the marks advertised, the largest number of those for w very old user is claimed, are from Sheffield, those are registered, in most instances, in Cl 5, 6, 12, and 13. One of these marks dates nearly two hundred years; a large propo upwards of one hundred years.* Of the applied for soon after the opening of register, one, that of Köpke's port wines, as far back as 1638. Six others trace origin to a date between one hundred fifty and two hundred years ago; whilst than thirty marks show a user of upwards hundred years. Amongst the oldest mar several registered in the name of the Ki Saxony (Class 16), dating from the year 173 words "The Coffee Mill," registered in classes by Messrs. Berry Brothers, of Londo a user of one hundred and fifty-five years December, 1875. The name "Wedgwood been a trade mark since 1776. Some of Offley's port brands are older still. Croft from 1776. Messrs. N. Johnston and So Messrs. Hunt, Roope, and Co. claim upw one hundred years user for their wine Messrs. Taylor, Fladgate, and Yeatman upw one hundred and fifty years for theirs. G brandy mark has a user of one hundred and years; Ruinart's champagne, one of a hund fifty years. The words "Singleton's Golde ment" stand registered in Class 3 with a user one hundred and two years before 1876. The g of Messrs. Farquharson, of Aberdeen, carry bearing the date 1694, although under its tration it is only modestly claimed as hav wards of one hundred years' user. One Chocolat-"Lombart" labels dates its user since 1760. The Kendal tweeds of Messrs.

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* This has been laid down by the Master of the Rolls in his own Court and recognised by Vice-Chancellor Hall. Would the Court of Appeal and House of Lords recognise it as warranted under the Act?

Fir

* George Wostenholm and Son, Limited, Washington Works, Sheffield....................
John Nowill and Sons, Nowill's Cutlery Works, Sheffield....................
John Kenyon and Co., Sheffield ....
William Hall, Sheffield ....
Edgar Allen and Co., Well Meadows Steel Works, Sheffield ....
T. R. Cadman, 211, St. Mary's-road, Sheffield ....
J. R. Spencer and Son, Albion Steel Works, Sheffield
John Pitchford, Sheffield....................
Isaac Greaves, Sheffield ....
Joseph Rodgers and Sons, Limited, 6, Norfolk-street, Sheffield ....
John Wilson, Sycamore-street, Sheffield ....
Rawson Bros., 21, Carver-street, Sheffield ....
Joseph Wostenholm and Sons, Perseverance Works, Penistone-road, Sheffield....................
Gregory and Bramall, Soho Steel Works, Sheffield ...
William Wilkinson and Sons, Grimesthorpe, Sheffield
Peter Stubbs, Rotherham and Warrington ....
S. and R. Linley, Clough Works, Sheffield ....
Saynor, Cooke, and Ridal, Paxton Works, Edward-street, Sheffield ....

rade mark dating from 1776. Messrs. nd Westall's salt mark, the "Horse," is of one hundred years old. Many of marks have a user of upwards of one years.

be observed that marks which claim the ntiquity are not always those the most own. Messrs. Bass' beer label, with the which was tendered for registration on the ay, and will go down to posterity as No. 1 glish register, had a user of only twenty ned for it on January 1, 1876. Farina's logne marks, the first on the German t Cologne, and presented quite early for n in this country, date less than fifty , though the house has been established eginning of the last century.

ION MEDALS.—Medals are registered as ld trade marks, if used as such before th, 1875. A difference is thus created carcely fair to manufacturers who pre- that date had gained such distinctions, made the same use of them. Medals, it cided, are not in themselves trade marks. gful use, however, is made penal under tion Medals Act, 1863, so far as concerns tions of 1851 and 1862, but so far only. t was fully dealt with in a paper con- Mr. Willis-Bund to the Paris Congress lready referred to.* The position of hen grouped so as in themselves to stitute a trade mark, or when used as de marks introduced since the passing stration Act in 1875, cannot be regarded e than most unsatisfactory. It is con- to urge upon the Government next introduce a Medals Amendment Bill to hibitions—national and international— under Royal or other Commissions, or recognition of the Board of Trade. trade marks, or parts of the same, ions of exhibition medals have to be common to a large class of persons, ot to everybody. A medal can never be ark of any individual.

MARKS EXHIBITION.—For use in the evening, I have, at the request of the ad brought here the volumes consti- it is known as the "Trade Marks " In this collection, each of the s in which trade marks are registered arate volume or volumes, and index. or each particular trade is thus facili- ere are three general indexes to the n, provincial, and foreign and colonial. ition was opened in July, 1877, at hen certain provisions of the Act came ion. The convenient and complete erence which the volumes present has of much service in many leading cases. stances, litigation has been avoided ice by those concerned. Concurrently ening of the exhibition, was commenced tion of *Trade Marks*, a journal, of ty-six numbers were issued. In many is journal is a near approach to the *la Propriété Industrielle Artistique et Littéraire*, edited by Pataille, of Paris, which has done so much service as an exponent of the French law on patents, copyright, and trade marks. In *Trade Marks* the endeavour has been so to deal with the subject as to record as fully as possible, and to comment upon all matters of law and fact, interesting to the owners of trade marks in this country.

The subject of trade marks is by no means new to this Society. It was last brought prominently under notice in a paper read by the present secretary, Mr. H. Trueman Wood, in November, 1875.* In 1859, Professor Leone Levi read a paper† on the subject before the Society, and drafted a Bill to be submitted to Parliament. The late Mr. Arthur Ryland, of Birmingham, about the same time read a paper before the Social Science Association. At this period Sheffield was complaining loudly of the systematic forgery of its trade marks in Germany. Early in 1860, Mr. Bass moved in the matter, and under his instructions Mr. J. Travers Smith submitted a draft Bill to Mr. Milner Gibson, then President of the Board of Trade. In 1861, the late Lord Campbell introduced a Bill in the House of Lords. Mr. Milner Gibson and the Attorney-General, in 1862, introduced the Merchandise Marks Act, and at the same time a Trade Marks Bill was brought in by the late Mr. Roebuck and Mr. Hadfield, the members for Sheffield. The two Bills were referred to a select committee, receiving very full consideration. Mr. Hindmarch, Q.C., and the Attorney-General were adverse to registration, which was provided for under Mr. Roebuck's Bill, but not included in the Government Bill, and recommended that at that stage of legislation it should not be inaugurated. The Merchandise Marks Act, 1862, in the result, was passed, and came into operation in January, 1864. That Act has proved most useful, by its deterrent effect, although the number of cases in which it has been put into operation have been but few. In July, 1863, followed the Exhibition Medals Act, the result of the efforts of a committee constituted here one month previously on my representation to the Council of the importance of taking prompt action. This measure was passed through both Houses of Parliament in seven days. A Trade Marks Registration Bill was again brought in by Mr. Bass in 1866. Another Bill for the same purpose was introduced in the House of Commons in 1868. In 1869, followed the Bill of Mr. John Bright and Mr. Shaw-Lefevre. Mr. Chichester Fortescue (Lord Carlingford), conjointly with Mr. Arthur Peel, made another attempt at passing a Bill in 1873, but equally without success. It was left for Lord Cairns, in 1875, to carry through a measure to effect what had been so frequently before attempted, without result. Registration had always been urged upon the Government by the Associated Chambers of Commerce and other public bodies, but there prevailed a divergence of opinion as to whether legislation on the subject should in the first instance provide for a compulsory or a voluntary system. Many

* nternational de la Propriété Industrielle," No. 24, s: Imprimerie Nationale, 1879.

* The Registration of Trade Marks." By H. Trueman Wood, B.A. November 24, 1875. *Journal*, November 26, 1875, vol. xxiv., p. 17.

† "On Trade Marks." By Prof. Leone Levi. March 16, 1859. *Journal*, March 18, 1859, vol. vii., p. 262.

influential deputations waited on the successive Presidents of the Board of Trade concerned in the proposed Bills referred to, and on some occasions I remember their being accompanied by Members of the Council and of the Trade Marks Committee of this Society. One such committee on a large scale was formed early in 1866, and on that occasion I had the honour to act as reporter. Soon afterwards Mr. Underdown read a paper* in this room on the "Piracy of Trade Marks." This was followed by another by Mr. Wybrow Robertson, in 1869.†

In his paper, in 1875, Mr. Wood threw out very valuable suggestions as to the mode in which the then recently passed Act might, with most benefit, be carried out. A Society of Arts Committee was formed, and held several meetings, ultimately submitting certain suggestions as to rules and regulations to the Lord Chancellor. In many respects the rules accord with the suggestions then made, notably as regards the statutory declaration and the mode in which applications are prepared, the subsequent advertising and the interval prior to registration.

The five years that have meanwhile elapsed may be considered as having afforded an ample test of the working of the Act. The rules, as at first settled, have in almost all respects remained unaltered, various additional rules being made from time to time, as circumstances required. The experience gained has left but few points to be dealt with. The present time is opportune for reviewing the result of the working of the Act. The expiry of the fifth year is the date at which the marks first applied for under the third section of the Act, commenced to acquire indisputable title as the exclusive property of the owners. In regard to this, it may be mentioned that the registrar, in July last, wisely called the attention of the Manchester Chamber of Commerce, and other public bodies, to the necessity of their causing an examination to be made of the trade marks registered during the five years then shortly to expire, with a view to taking the necessary steps for preventing any such marks which were of a general nature passing into the hands of individuals whose registrations ought to be previously cancelled. This notification from the registrar, so far as I have been able to learn, did not lead to the combined action which might have been expected. As, however, but comparatively a very limited number of marks have even now passed into the indisputable stage, there is time yet for carefully reviewing the bulk of what are on the register. In the absence of any public functionary to undertake the duty of such revision, I shall myself be willing to cooperate with any associated bodies of traders or individuals interested in taking action in this direction.

Within the limits of this paper it is impossible to deal exhaustively with any of the subjects to which it refers. I have endeavoured briefly to glance at the most important points in the commercial aspect, equally as with those of a legal nature. For what I have said in connection with the latter, I am indebted in a great measure to Mr. Willis-Bund, Mr. Israel Davis, Mr. Sebastian, an[d] Howard Paddison, who have been concern[ed in] many of the cases to which reference is mad[e] statistical information, subsequent to wh[at has] been already published in the reports of th[e Com]missioners of Patents, I am indebted t[o the] courtesy of the registrar.

The day, I trust, may not be far distant w[hen a] Supplemental Trade Mark Act may be passe[d with] the view of varying the definition of a trad[e mark] in such a manner as to embrace an origina[l] name among the essential particulars, and t[o] of a letter or figure being registered as [a] mark, and added to any one or more of the e[ssential] particulars of any new mark. Power, und[er] an Act, might be reserved for the regis[trar to] cancel, after a specified period, all applicati[ons not] completed owing to the non-payment of re[gistra]tion fees.

The mercantile community would gladl[y avail] themselves of the permission to record trad[e marks] under a special system of registration, si[milar to] that adopted in America. In any new Act I [should] like to see such a system provided for.

The rules might, I think, be advant[ageously] varied, by giving the registrar power to a[lter the] register, in respect of trivial alterations in r[egistered] marks, without application to the Cou[rt, and] where collision is impossible, to per[mit] mutually consenting persons to be inte[rested in] the same mark in respect of goods of [a] different kind, although comprised in the s[ame class.]

My own feeling is that these A[cts have] inaugurated a new era in the history [of] commerce. For the outlay of an almost [nominal] sum, the smallest as well as the largest [manufac]turer in the kingdom, by the registration [of his] mark, can secure to himself, his succ[essors and] assigns, the absolute and exclusive right t[o use that] mark in connection with his goods, and t[he goods or] any particular class of them sold with th[at mark] being of an unvarying and standard [degree of] excellence. The public, on the other h[and, learn] to look upon the manufacturer's trade [mark as a] guarantee of such standard degree fr[om which] they know he cannot depart, except unde[r the penalty] of losing both credit and custom. Thus, [the trade] mark affords security to the purchaser; [and makes] honesty the best policy on the part of t[he manu]facturer.

DISCUSSION.

The Chairman said there were probably [many] present who had had experience of trade [marks] used in this country, and as used by o[ur foreign] competitors, and if so, he should be gla[d to hear] their views. They knew that England for [many years] enjoyed an almost unique reputation with re[gard to] certain manufactures, such as cotton and st[eel,] and many of the marks of English manufac[turers had] consequently acquired great value in foreign [markets.] But, in some foreign countries, where the Eng[lish] mark was not recognised as a property, the n[ative com]petitor had coolly appropriated it, and, ther[eby] acquired, in the native market, a right t[o the] English trade mark, whilst the original own[er of the] mark in England had no protection at all. [He (the] Chairman) knew of a case where an English [manufac]turer had gone to France and asked to be a[llowed to] register his own old mark, but the applicatio[n]

* On the Piracy of Trade Marks." By E. M. Underdown. April 11, 1866. *Journal*, April 13, 1866, vol. xiv., p. 370.

† On Trade Marks." By W. Wybrow Robertson. April 21, 1869. *Journal*, April 23, 1869, vol. xvii., p. 14.

because the same mark had been used in France renchman. If the French maker were to make lication in this country to register the mark for se class of goods, it would be sufficient for him it was an old mark used prior to 1875, without where it had been so used, and it was doubtful Englishman could successfully oppose the appli- because three persons, but not more, were allowed ter the same mark, if an old one. The question robably arise some day, to what extent did the a foreigner in his own country, entitle him to declaration that he had used a mark for a certain of years, so as to obtain registration in England.

alman (solicitor to the Trade Marks Protection said he had had considerable experience in bject, which was a very complicated one, ault to speak upon off-hand. Mr. Johnson ted it in a very able manner. He might ord or two, however, on the question of the egistration of English marks. Recently, laws passed for the protection of trade marks in and, Holland, and Denmark, but, in the case of latter countries, there were provisions which reat hardship to English manufacturers. There very old marks called cutlers' marks—Sheffield marks—consisting of letters, which had, of een registered in England as old marks, but in and Denmark the law did not provide for the on of letters. The society he represented had esentations to the authorities of those countries he Foreign-office, but up to the present time refused to register these marks. In Switzer- uthorities had seen the justice of registering which had received the protection of the England. He considered that when these about to be passed in foreign countries, there ave been at least some attempt to co-operate gland and other countries, so that these should not occur. With regard to certificates , though they placed the owner of the mark id in the same position as he was before with prosecuting infringers, in foreign countries no such effect. If the Courts in England tection to the owner of a trade mark, that be sufficient to entitle him to protection in a untry, and the foreigner ought not to be able to the mark with impunity, as he did at present. l be very glad to co-operate with Mr. Johnson ny body of gentlemen interested in the sub- he purpose of obtaining an amendment of the ugh he must say it had on the whole worked hy three persons should be allowed to register mark, and not four, he did not understand, id been so decided. The question of costs another important matter which ought to be ed.

llis-Bund thought there were one or two ich might be usefully discussed in view of further legislation. There was first the ut foreign manufactures, which was compli- hose cases in which British subjects have gone d registered fraudulent imitations of English d the question might arise whether such persons able to come afterwards and register those t marks in England. The main point to which to direct attention was the definition of a trade the necessity of endeavours to obtain some new ehensive definition. This could not be done off- when it was done they ought to have the co- of foreign countries in the matter. If they ave an international law of trade marks, they t of all decide what was a trade mark. to him that the Act of 1875 had rather in- s difficulties, because now there were no less distinct classes of trade mark. Old trade gistered under the Act, and old marks not registered, each of which had different rights attaching to them, and which would be treated differently in English Courts and abroad. Then there were new marks registered, and new marks not registered, and here, again, there were different rights existing. They wanted some comprehensive definition which would in- clude all these. There was another important question which Mr. Johnson had briefly alluded to, viz., the case of special words which described a patent article. He had in his mind the case of linoleum. As he under- stood the law, it was this:—If a man took out a patent for an article and called it by a fancy name, at the ex- piration of the patent anybody could make the article and call it by that name, whereas if he registered it as a trade mark, that result would not follow. The question was, ought he to be able to register the fancy name as a trade mark or not? Ought he to obtain a greater monopoly by registering a trade mark than by taking out a patent? Some day the important question might arise with regard to zoedone, and other articles of that description, whether anybody might not make them and sell them under the same name. That question ought not to be left in doubt, but to be decided by legislation as soon as possible. Another point was with regard to piracy, and it seemed to him that as the law now stood, pirates had a great advantage. If several pirates chose to combine and send in representations of a mark for registration, alleging user, which, no doubt, they could do, although it was a piracy, they would deprive the legitimate owner of his right to the mark; and would make what was private property common property. He believed that had been done extensively in the case of cotton marks, and might be done in other classes; and it evidently required some legislative remedy. It had been laid down by the Commissioners of Patents that three marks of a similar character might be registered; that principle had never been recognised by any appellate Court, and some day they might be astonished to find that a mark, registered more than once, had ceased to be distinctive. With regard to British manufacturers abroad, he recollected several cases of cotton marks, where the owners of well-known marks in this country had been refused registration in Germany, because some German manufacturer chose to say that he had used the same mark in some small town in that country, on some reels of cotton. He would suggest that it would be well to bring before the Govern- ment, whenever the Trade Mark Act was altered, the importance of endeavouring to come to some agreement with all those countries with which we had trade mark treaties, as to what was a trade mark, and to form a system by which registration in one country should be equivalent to registration in all countries, and by which the mark of a manufacturer should be protected every- where by the mere fact of being registered in his own country.

Mr. Sebastian said the first remark which occurred to him was with reference to the jurisdiction of the Commissioners of Patents. They gave instructions to the registrar as to the manner in which he should carry out his duties, and in the first case which came before the Court, Vice-Chancellor Malins seemed to think that their decision was final; but it was not held to be so now: and the question really was what their jurisdiction amounted to. There was a case in which they instructed the registrar not to register any marks consisting of foreign words or letters, and he accordingly refused to register the word Todd, which was the name of a maker of watches, and was also an Arabic word, meaning mountain. The Court, how- ever, directed him to register it; the registrar appealed, acting, no doubt, under instructions from the Commis- sioners, but the Court of Appeal affirmed the decision, and the mark was registered. There the instructions of the Commissioners went for nothing; and this question was of importance with regard to point of three owners registering the same mark. The Commissioners had given

instructions that three persons might be registered, but there was no authority for that in the Act, or in the rules. As Mr. Johnson had suggested, it might be useful if some enlarged powers were given to the registrar with regard to altering the register in unimportant particulars, without an application to the Court, though he had not the same dread of that process as Mr. Johnson seemed to have. Enlarged powers might also be given to the Court for rectifying the register. One member of the firm carrying on a very extensive business, registered the firm's trade mark in his own name, for the benefit of the firm, the other partners co-operating with him, and it was held that that registration could not be transferred into the name of the firm. He thought too much attention was paid to the office fees; and with regard to costs, the Court had looked rather too tenderly after the interests of the office. When the Court reversed the decision of the registrar, and ordered a mark to be registered which he had refused, he not only paid no costs, but was paid his own. He (Mr. Sebastian) thought it was a mistake that fancy names should not be registered, as they were in almost all foreign countries, and as they were here in the case of old marks. Of course there was the difficulty which had been mentioned with regard to patent articles under fancy names obtaining greater protection than the Patent-law allowed, but there might be a power of discriminating between fancy names which would become descriptive of the article and those which could not become so. As to the custom which had been referred to, of registering fancy names in connection with a signature, it was to him very difficult to understand how words registered under such circumstances could be protected. The Act said that a trade mark should consist of certain essential particulars, in which these fancy names were not included, though a signature was; and it went on to say that, to such essential particulars, certain immaterial matters might be added. He did not understand how an immaterial addition could be protected. A great many people thought they ought to be protected, but the question was whether they were so at present. In the only decision yet given by the House of Lords on the Act, it was held that such immaterial additions to the signature ought not to be registered. It had been suggested that the object might be attained by registering a device, such as the head of some animal, thus causing the article to acquire the name of the animal; and a very recent case had shown the force of that observation. One man registered a bulldog's head, and another used a terrier's head, but the article to which the mark was attached had become known in the market as dog's head ale, and the result was that one dog's head excluded from registration another dog's head, which was totally different.

Mr. E. J. Watherston said that it appeared to him that the gist of the able paper they had listened to was contained in the concluding paragraph, just as that of most petitions was contained in their prayer. The moral, both of the paper and the discussion which had followed, proved most conclusively the necessity for a Minister of Commerce. This subject had been discussed, time after time, not only by the Society of Arts, but also by the Social Science Association, and by the various Chambers of Commerce throughout the country. The fact was that Parliament had no time to discuss questions of trade interest. It was necessary, therefore, that such subjects should previously have been considered by a Government department, and that a proper digest should be prepared by those best calculated to frame legislation. There were two Bills now before Parliament of a similar character, in regard to Copyright and Patent-laws, which should be considered together with the laws relating to trade marks. In compliance with the expressed desire of the author of the paper and a previous speaker, he would, as a member of the Council of the National Chamber of Trade, offer the services of that association, by whom an effort would be made to give effect to the proposals contained in the paper, in order that p
opinion might be formed upon the subject.

Mr. Israel Davis was much gratified at findi
necessity for unifying the definition of a trade
throughout the world so generally recognised. H
not know whether any practical suggestion had
thrown out how this could be accomplished, but a
cedent existed in the action of one of the Govern
departments, in carrying out a similar object. It
necessary to introduce a uniform code of signal
vessels, and that had been done amongst all the n
of the world which had any commerce, by the age
the Board of Trade. After long and compl
negociations, a general code of signals and a r
the road at sea had been adopted, to which all n
gave in their adhesion; and not only was
effected once, but afterwards, when it b
necessary to change the rule of the road,
negociations were set on foot, and the ru
changed with unanimous concurrence. This
cedent was an encouraging one, and tended to sho
it was not impossible to attain the great obje
uniform definition of a trade mark, which shoul
the industries of all the countries of the world. W
they should adopt the suggestion thrown out b
Willis-Bund that registration in one country sh
equivalent to registration in all, was another q
and he should be inclined to dissent from that v
would be very hard that a trader in Spain sh
bound to know all the marks which existed
London register, or that a trader in Paraguay
be bound to know of all the marks exi
Melbourne; nor was it at all necessary th
marks should be registered in foreign co
Many trade marks were used for articles whic
only used in the vicinity of the manufactory,
others went all over the world; and there migh
option, and a different scale of fees for marks us
in the home trade, and for those which should ap
all the countries which belonged to the trade mar
vention. That point, he thought, might be left t
care of itself. The first step would be to get the
of Trade to endeavour to obtain a universal defin
a trade mark; and he thought the Society of
might usefully bring the matter before the Govern
Allusion had been made to unregistered trade m
and the certificate of refusal, which was found no
so efficacious in foreign countries as might have
expected. Here it left the manufacturer free to
an action against an infringer, but, abroad, it d
furnish that evidence of title which the foreign reg
tion office required. It occurred to him that a
simple alteration would meet the difficulty. If th
could be altered, so that instead of giving a cert
of refusal, the office issued a certificate of reg
without prejudice, or of provisional registry, or
kind of certificate showing the mark was in a dif
class from others, but still that it had been regis
he thought the difficulty would be got over.

Mr. Johnson, in reply, said he was sorry to hear
Mr. Salaman that so much difficulty existed in Ho
and Denmark. He quite agreed with Mr. Davis,
the form of certificate of refusal might be improv
present it was a most bald document, simply stating
registration had been refused, with no explanation;
one could well understand that, when presented t
foreign Court, so far from being of any service in
lishing the authenticity of the mark, it acted pr
cially. It might, at any rate, be altered so as to
on the face of it why it was given, instead of a c
cate of registration; that the mark was not regi
simply as the result of accident, rather than from
impropriety in the mark itself, or any wrongful
on the part of the owner. He thought countries
had lately introduced registration of trade marks
reasonably have provided for recognising all th—

in other countries, and, in fact, have confirmed hey ought, as juniors in the matter, to have their seniors, and thrown no obstacles in the way rks recognised elsewhere. Mr. Bund's remarks riumvirate of pirates were very important; ict that such combinations really had occurred strongest possible reason for the matter being The distinctions between old and new marks ainly most complicated, and as there were so ferent kinds of marks, it was really very o know what was a trade mark, and what was e question of costs, to which Mr. Sebastian led, was one on which the public felt very t was very hard that the refusal of the registrar, e informality, or some peculiarity in the inter- of the Act, should involve an applica- the Court, and, if the registrar persisted, l, and, finally, an appeal to the House of id yet that the unfortunate applicant, though ., should have to pay three sets of costs twice ith reference to fancy names, Mr. Sebastian ntly of opinion that they were not properly l at all, but if that view were correct, why ey get on the register? He could not under- iy they should get on the register, and yet status by being there. It would certainly be vantage to have a test case tried, and if a com- ere formed, which he hoped might be the out- he present discussion, and if they could get up e, involving all the points which they could combine in it, it would be of great value. They ig it first before the Master of the Rolls, then ie Appeal Court, and ultimately before the Lords, and thus get many of these difficult decided.

cretary said he had no doubt the Council of ty of Arts would give very careful considera- iny application which might be made with to the formation of a committee on this im- uestion.

airman then proposed a vote of thanks to Mr. for his able paper, and for the impetus which he i to a movement which it was to be hoped would that evening. It seemed to be the general that an association or committee should be o see in what way the working of the Trade cts could be improved, and how difficultie id arisen under the existing system could be it would be very satisfactory indeed if such a result should follow from the reading of the

te of thanks was carried unanimously, and the igs terminated.

GENERAL NOTES.

nd Steel Institute.—The annual meeting of ute will be held on Wednesday, May 4th, and two days, in the hall of the Institution of Civil i. The president elect (Mr. Josiah T. Smith) will s inaugural address on the first day.

es on Plumbing.—A course of six lectures on ience and Art of Sanitary Plumbing" will be given auspices of the National Health Society by Mr. s Hellyer, at the House of the Society of Arts, on June 1, 14, 28, July 12, 28, at 7.30. p.m. The rill be especially addressed to working plumbers, rated by examples, diagrams and working models, ustrations. Examinations of a practical nature ld at the close of the course, and two large silver everal smaller silver and bronze medals and certifi- roficiency will be awarded by the National Health

Copyright Bill.—A meeting of the Law Amendment Society will be held on Monday evening, May 2, at 8 p.m., at 1, Adam-street, Adelphi, when a discussion on the Copyright Bill promoted by the Society, will be opened by Mr. John Westlake, Q.C., LL.D. Lord Reay will take the chair.

Royal Albert Hall.—Amongst the arrangements for the season at the Royal Albert Hall, it is announced that eight oratorio concerts will be given, at which Mr. Sims Reeves will sing in oratorio for the last time. The first of these concerts was held on the 27th of April, and the last will be on Saturday morning, the 9th of July. It is stated that at this last-mentioned concert Mr. Sims Reeves will make his last appearance in oratorio.

Iron Sleepers.—In this country iron sleepers have only been used experimentally, but in Belgium and Germany they have been employed for a considerable time. In the past two years it is calculated, say Messrs. Bolling and Lowe in their report, that nearly 130,000 tons have been placed on the German railways. In Germany there are many hundred miles of line running through sandy districts, for which the iron sleeper is said to be well suited.

Blast Furnace Cinder, so long regarded as a waste product, is thus treated at the Sclessin Iron Works near Liége, Belgium. The molten *slag*, as it is commonly, though inaccurately called, flows direct from the blast furnace into a stream of cold water, whereby it assumes a finely-divided condition, like coarse sand. It is raised by an elevator, deposited in wagons, and sent away at once, to serve as railway ballast for which purpose it is well suited.

Artificial Stone.—In the report on the Exhibition of Applied Science, Paris, 1879 (*Journal* vol. xxviii, p. 164), the articles of artificial stone, by M. Dumesnil, were referred to. This substance is composed as follows:—In 500 litres (110 gals.) of water, are dissolved 7 kilos. (15½ lbs.) of alum, 6 kilos. (13¼ lbs.) of slaked lime, and 1 kilo. (2¼ lbs.) of yellow ochre, to which is added 1 kilo. of glue dissolved in 5 litres (1 gal.) of hot water. In this mixture, 900 litres (198 gals.) of plaster of paris are tempered, and then half that quantity of fine river sand, free from clay, is added. This preparation, run in moulds, sets in about twelve hours, and acquires great hardness. To protect the building blocks, thus obtained, from the action of rain, it is sufficient to give them three coats of silicate of potass dissolved in water.

Tobacco in France.—The following table from a recent report shows that the consumption of tobacco in France has been steadily increasing:—

	Population.	Amount consumed. Kilogrammes.	Amount per head. Grammes.
1815	29,250,000	8,981,403	307
1826	31,673'853	11,595,084	366
1831	32,731,256	11,071,088	338
1841	34,018,715	16,461,934	484
1851	35,546,919	19,718,089	555
1864	37,133,424	28,019,803	755
1866	37,807,203	30,627,663	810
1872	35,844,414	27,031,000	754
1876	36,643,087	31,188,846	851

The amount consumed in the different departments varies very much. Snuff-taking is most practised in Oise, Seine Inférieure, Eure, and Eure-et-Loir, at the maximum rate of 375 grammes per head; and least in the departments of Doubs, Pyrénées Orientales, Nord, Haut Rhin, and Haute Savoie, where the average is but 100 grammes. In smoking, however, there is rather a reverse order of things, the Nord, Haut-Rhin, and Pas-de-Calais consuming at the rate of two kilogrammes per head, while the minimum is found in Haute Savoie, Cantal, Corrèze, Creuse, Aveyron, Dordogne, Lot, and Lozère. Ten departments only consume tobacco above the average, while 70 are actually below it. If all France smoked the same quantity as do the people of Nord, Haut-Rhin, and Pas-de-Calais, the consumption for the whole country would be 73,286,174 kilogrammes, instead of 31,000,000; and *vice versa* it would be only 6,265,968 kilogrammes if calculated according to the average of Lozère, which is only at the rate of 171 grammes per head.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock:—

MAY 4.—"Buying and Selling; its Nature and its Tools." By Professor BONAMY PRICE, M.A. Lord ALFRED S. CHURCHILL will preside.

MAY 11.—"The Manufacture of Glass for Decorative Purposes." By H. J. POWELL (Whitefriars Glass Works). WILLIAM SPOTTISWOODE, LL.D., P.R.S., will preside.

MAY 18.—"The Electrical Railway, and the Transmission of Power by Electricity." By ALEXANDER SIEMENS. Dr. SIEMENS, F.R.S., will preside.

FOREIGN AND COLONIAL SECTION.

Tuesday evenings, at eight o'clock:—

MAY 10.—"Trade Relations between Great Britain and her Dependencies." By WILLIAM WESTGARTH.

APPLIED CHEMISTRY AND PHYSICS SECTION.

Thursday evenings, at eight o'clock:—

MAY 12.—"Recent Progress in the Manufacture and Applications of Steel." By Prof. A. K. HUNTINGTON.

MAY 26.—"Telegraphic Photography." By SHELFORD BIDWELL. Prof. W. G. ADAMS, F.R.S., will preside.

INDIAN SECTION.

Friday evenings, at eight o'clock:—

APRIL 29.—"The Building Arts of India." By General MACLAGAN. ANDREW CASSELS, Member of the Indian Council, will preside.

MAY 13.—"Burmah." By General Sir ARTHUR PHAYRE, G.C.M.G., K.C.S.I., C.B. Sir RUTHERFORD ALCOCK, K.C.B., will preside.

Members are requested to notice that it may be necessary to make alterations in the dates of the above papers.

CANTOR LECTURES.

Monday evenings, at eight o'clock:—

The Fourth Course will be on "The Art of Lace-making," by ALAN S. COLE. Four Lectures.

Syllabus of the Course.

LECTURE III.—MAY 2.

Fringes. Twisted thread-work in England in the 15th century. Early designs for plaited and twisted threads. Italian, Flemish, French, and English pillow lace. Laces of primitive design.

LECTURE IV.—MAY 9.

Resumé as to styles of design in hand-made lace. Traditional patterns. Sketch of the development of inventions for knitting and weaving threads to imitate lace. Differences between machine and hand-made laces. Modern hand-made laces at Burano, Bruges, Honiton, &c.

This course will be illustrated by specimens of lace. Diagrams and photographs enlarged will be shown by means of the lantern and oxyhydrogen light.

The Fifth Course will be on "Colour Blindness and its Influence upon Various Industries," by R. BRUDENELL CARTER, F.R.C.S. Three Lectures. May 16, 23, 30.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 2ND...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. Alan S. Cole, "The Art of Lace-making." (Lecture III.)
Farmers' Club, Inns of Court Hotel, Holbo 4 p.m. Mr. T. Duckham, "The Effect of L Owned by Corporate Bodies."
Royal Institution, Albemarle-street, W., 2 p.m. Meeting.
Institute of Surveyors, 12, Great George-str 8 p.m. Mr. G. M. Freeman, "Land Law Ref
Medical, 11, Chandos-street, W., 8½ p.m. Oration.
Victoria Institute, 7, Adelphi-terrace, W.C., 8 p W. D. Ground, "An Examination of the I of Mr. Herbert Spencer."
Law Amendment Society, 1, Adam-street, Adel 8 p.m. A Discussion on the "Copyright I being promoted by the Society, to be open statement by Dr. John Westlake.

TUESDAY, MAY 3RD...Royal Institution, Albemarle-st 3 p.m. Prof. Dewar, "The Non-Metallic E (Lecture II.)
Central Chamber of Agriculture (at the Hou SOCIETY OF ARTS), 11 a.m.
Civil Engineers, 25, Great George-street, We S.W., 8 p.m. Discussion on Mr. Walter R. Paper, "The Relative Value of Upland Waters in Producing Scour."
Pathological, 53, Berners-street, Oxford-st 8½ p.m.
Biblical Archæology, 9, Conduit-street, W., 8 p. Ernest de Bunsen, "The date of Menes." Eisenlohr, "An Historical Inscription."
Zoological, 11, Hanover-square, W., 8½ p.m. 1. Parker, "Some Points in the Anatomy of t in the Hare and Rabbit." 2. Prof. F. Je "Contributions to the systematic arrangem *Asteroidea*. Part I., "The species of the genu 3. Dr. M. Watson, "Additional Observati Anatomy of the Spotted Hyæna." 4. M Thomas, "The Indian species of the genus

WEDNESDAY, MAY 4TH...SOCIETY OF ARTS, J Adelphi, W.C., 8 p.m. Prof Bonamy Pric and Selling; its Nature and its Tools."
Iron and Steel Institute, 25, Great George-st 10½ a.m., General Meeting of Members. The Elect (Josiah T. Smith, Esq.) will deliver hi Address. A Selection of Papers will be re cussed.
Entomological, 11, Chandos-street, W., 7 p.m.
Archæological Institute, 16, New Burlington- 4½ p.m. Annual General Meeting.
Obstetrical, 53, Berners-street, Oxford-street,

THURSDAY, MAY 5TH...Royal, Burlington-house, W., 4
Antiquaries, Burlington-house, W., 8½ p.m.
Linnean, Burlington-house, W., 8 p.m. 1. P Balfour, "The Dragon's Blood Tree and its 2. Prof. G. Busk, "New Species of *Cellepo* *Challenger* Expedition." 3. Prof. Bayley Bal Genera of Plants from Madagascar."
Chemical, Burlington-house, W., 8 p.m. 1 the Election of Fellows. 2. Mr. E. W. Pr Action of Humic Acid on Atmospheric Nit Mr. R. T. Plimpton, "The Active and Inac mines." 4. Mr. L. D. Thorne, "The Prod Action of Alkalies on Ethyl β. Ethylaceto- 5. Mr. T. Purdie, "The Action of Sodium on Fumaric Ether."
South London Photographic (at the Hou SOCIETY OF ARTS), 8 p.m.
Royal Institution, Albermarle-street, W., 3 Tyndall, "Paramagnetism and Diamagnetis ture II.)
Iron and Steel Institute, 25, Great George-st 10 a.m. Reading and Discussion of Papers
Civil and Mechanical Engineers, 7, Westminste S.W., 7 p.m. Annual Meeting.

FRIDAY, MAY 6TH....Royal United Service Institute, yard, 3 p.m. Captain J. T. Bucknill, "The of Buildings from Lightning."
Royal Institution, Albemarle-street, W., 8 p.m. Meeting. 9 p.m. The Hon. George Brod Land Systems of England and of Ireland."
Geologists' Association, University College, W.
Philological, University College, W.C., 8 p.m. Martineau, "The Rhæto-Romanic Dialect."
Iron and Steel Institute, 25, Great George-st 10 a.m. Reading and Discussion of Papers and concluded.
Quekett Microscopical Club, University Coll 8 p.m.
National Health Society, 22, Hertford-street, (Drawing-room Lectures.) Mr. C. N. "Sanitary Relations of Local Self-Governm

SATURDAY, MAY 7TH...Royal Institution, Albemarle- 3 p.m. Prof. Henry Morley, "Scotland English Literature." (Part II.)

AL OF THE SOCIETY OF ARTS.

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FRIDAY, MAY 6, 1881.

cations for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

CANTOR LECTURES.

ird lecture of the fourth Course on "The ace-making" was delivered by ALAN S. Monday, 2nd inst. Attention was drawn dual growth of design, as exhibited in the Italian, Flemish, French, and English e, and the distinctive characteristics of Brussels, and Valenciennes lace were ut. A series of specimens of lace were , and enlarged photographs of repre- pieces were shown by means of the ad oxy-hydrogen light.

ART FURNITURE EXHIBITION.

parations for the Exhibition of Works of ed to Furniture at the Royal Albert Hall eing proceeded with, and it is expected Exhibition will be opened on Thursday, , at the same time as the General Art n at the Albert Hall.

EEDINGS OF THE SOCIETY.

D CHEMISTRY AND PHYSICS SECTION.

ay, April 28, 1881; ALLEN THOMPSON, R.S., in the chair.

per read was on—

PURITIES IN WATER, AND THEIR ENCE UPON ITS DOMESTIC UTILITY.

ge Stillingfleet Johnson, M.R.C.S., F.C.S.

re some impurities found in the water of re especially in those rivers which, like e immediate neighbourhood of this build- their course through large towns, g which I shall have little to say this I allude to organic impurities, the f living beings, sewage, and the like, and n for keeping silence upon this great subject is the incompleteness of our knowledge regarding it. Our highest medical authorities seem to be at variance as to the nature and degree of the baneful influence exerted by those impurities which I have mentioned upon the human economy, with the exception of the so-called specific poisonous products of such diseases as typhoid and cholera; and our highest chemical authorities are very much at variance as to the best method of estimating or determining the amount of these organic pollutions in waters, as they also are in the various accounts they give of the processes by which nature removes them. It would ill become me, therefore, to do more than hint at the existence of this source of contamination of water, unless I stood prepared to bring forward some new facts or experiments throwing light upon the subject, which I am not in a position to do. I must, therefore, confine myself this evening to the discussion of some of the more important inorganic impurities contained in natural waters, and their influence upon the domestic utility of the inportant liquid which contains them.

The word "impurities" has occurred several times already in this paper. I have also spoken of "pollutions" and "contaminations," all of which expressions tend to convey the idea that the presence of substances so described, in the water we drink and employ for household purposes generally, must needs be injurious and prejudicial. Now, the tendency of this paper will rather be to show the great usefulness of many of these so-called "impurities" in natural waters; and the word is used here in its strictly chemical sense, to indicate anything which we find in and accompanying water which is not the chemical compound, H_2O.

Pure water, the compound containing two atoms of hydrogen combined with one atom of oxygen, is a pure chemical substance which is never found in nature. We explain this by the statement that water exerts a solvent action upon various gases and solids.

It is, then, by virtue of its solvent action that water becomes impregnated with the impurities of which I am to speak; and I will, therefore, ask you to follow me while I make a few preliminary remarks upon, and show you a few experiments illustrating, the nature of solution. The process of solution consists essentially in a change of physical state, without alteration of chemical constitution. Thus, when sugar or common salt is dissolved in water, we can obtain the solid sugar or chloride of sodium by simply evaporating the water; and these are instances of true solution; but, if metallic copper be dissolved in nitric acid, that is an instance of solution accompanied by chemical change; for, if we evaporate the blue liquid thus obtained, we have a deposition, not of metallic copper, but of nitrate of copper, the salt formed by the chemical action which takes place between that metal and nitric acid. Solution proper, then, consists in a change of physical state simply without change of chemical constitution. Now, we know of but three physical states in which matter can exist, the solid, the liquid, and gaseous. The solvent or substance which brings other substances into solution is usually a liquid. The dissolved body may be either a solid or a gas.

Now, the physical state in which we find any

substance depends to a great extent upon the nature and intensity of the physical forces which happen to be acting upon it at the time. Besides the action of solvents, the two physical forces, heat and pressure, exert a powerful influence upon the physical state of matter. The essential difference between the three physical states of matter is one of the relative freedom of motion which exists between the molecules or ultimate particles of which the matter consists, the gaseous form of matter possessing the greatest, whilst the solid possesses the smallest, degree of molecular mobility. Heat, on the one hand, increases this mobility of the molecules of matter, whilst pressure has the reverse effect.

Next, observe that the solvent (liquid water, *e.g.*) is in the intermediate condition, as regards molecular mobility, between the solid and the gas, whose physical state it must assimilate with its own before it can bring them into solution. It follows, then, that the liquid solvent must bind a gas in chains, as it were, must diminish the free mobility which exists among the particles of that most elastic form of matter, whilst it will have to increase the molecular mobility of the comparatively sluggish solid, in order to make them respectively assume its own physical state. Accordingly, we should expect to find that a liquid will have its solvent action upon solids increased by the application of heat, whilst its power of dissolving gases will be diminished by heat, but improved by pressure. And these laws are obeyed in almost all instances.

I will now show you one or two experiments, to illustrate these preliminary remarks upon solution. When I stir up these two white powders in separate beakers of hot distilled water, you observe that one of them (which is powdered sugar) becomes readily incorporated with the water, changes its physical state, assuming that of its solvent, is dissolved. That is an instance of a soluble substance. This other powder, however, refuses to do anything but remain partially suspended in the water, making the liquid look milky, whilst the greater part of it (for it is very heavy) sinks and remains at the bottom of the beaker. It is the salt called sulphate of baryta, and is one of the most insoluble bodies known.

To illustrate the effect of heat in assisting the solution of a soluble solid substance in a liquid, it will be sufficient to cool this hot saturated solution of iodide of lead, when we find that water, which was capable of retaining a large quantity of that salt in the liquid state whilst hot, becomes incapable of doing so as it cools, and the excess of salt separates out from the solution in the crystalline form.

To demonstrate the action of heat in retarding the solution of a gas in a liquid, I will first pass up a little water into this tube (which contains dry ammonia gas confined over mercury). As soon as the water reaches the gas, you see that the latter disappears, being dissolved by the water. Now, if I pour a little hot water over the outside of the tube, we shall soon see the effect of heat in increasing the molecular mobility of the ammonia, for the restraining power of the water, at this high temperature, becomes insufficient to control the elasticity of its volatile companion, and the ammonia bursts its chain and resumes the gaseous condition. As the tube cools again, the solvent power of the water is again triun and the gas disappears. Not only the temperature of the liquid solvent exert fluence upon the quantity and quality of stances which it is capable of dissolving; solvent action of a liquid is often consi modified by the presence therein of sul which it has already dissolved.

We will consider this influence of di matter in water upon its solvent action o forms of matter somewhat fully, since it to explain the presence of some of t purities found in waters; and it will b venient to divide the subject into two viz.:—

1. The influence of dissolved gases u solubility of solids.

2. The influence of dissolved solids u solubility of other solids.

1. Excluding those cases in which a c action occurs, resulting in the production insoluble compound by the action of a d gas upon one or the other of the elements in a dissolved solid, the general tendency dissolved gas to increase the solubility of their common solvent. As an illustration I will cover this solution of copper sulphat strong solution of ammonia gas in wat see now three layers in the containin Below the blue solution of copper sulpha the colourless solution of ammonia gas i and between the two, a light blue turb the turbidity of which is due to the prese of suspended hydrated oxide of copper, a s which is insoluble in pure water, and neutral and alkaline solutions, but which i in a solution of ammonia gas in water, a dark blue liquid, which you see is when I stir up the contents of the beake are other instances which will occur to every of solid bodies quite insoluble in pure water to the solvent action of a solution of ammo water. It appears, then, that the disso confers a degree of molecular mobility upon which has dissolved it, or at least ena water to produce the requisite freedom o amongst the molecules of an otherwise solid, which is necessary in order to com assume the liquid state.

2. It is frequently observed, and e amongst the halogen group of elements, insoluble salt is rendered soluble by the in their common solvent of a very solu body. One of the most striking and examples of this is seen in the case of the curic iodide, which is entirely insoluble water, but is readily dissolved by water with potassic iodide—a very soluble sal essential that the potassic iodide be pre somewhat concentrated solution, for, as y this beaker, when a solution of mercuric one of potassic iodide is mixed with a larg pure water, the red mercuric iodide separ If there be any chemical action between iodides in this case, it is of the very feebl Indeed, some experiments of my colleag J. M. Thomson, have tended to show th double salts formed by dissolving insolul gen compounds in soluble ones be comp all, they are molecular, not atomic comb

ıt all events, interesting to remark, that dissolved solid assists the solution of another ›dy, it is the more soluble substance—that s endowed with freest molecular mobility—serves to bring about the liquefaction of the luggish solid; and there are instances of tion which cannot be at all explained by al action, as in the case of the solubility of ime in a strong solution of sugar.

metimes happens that the action of a solvent sted, by the formation of a protecting film nsoluble substance upon the surface of an ed solid. Thus, marble, which is a compact line variety of carbonate of lime, is freely ed by a solution of hydrochloric acid gas in the only solid product of the accompanying l action being the salt known as calcic). Now, calcic chloride is freely dissolved r, and, as each particle of it is formed on ace of the marble, it is dissolved off by the nd fresh surfaces of marble are constantly to the action of the hydrochloric acid. we immerse marble in water containing drochloric acid and sulphuric acid in solu- surface speedily becomes covered with an e film of calcic sulphate, and the action Marble is still there in abundance; hydro- ıcid is also present in quantity, adequate cient for its solution; but, by reason of the ing insoluble film of calcic sulphate, they rented from acting upon one another. ıemical force can only act at infinitesimally stances." Another instance of the pro- ction of an insoluble film upon the surface ıerwise soluble solid is seen in the case of k ferrous sulphide. When this substance upon by sulphuric acid, the salt known as ulphate is produced. Now, green vitriol, ıs sulphate does not dissolve in cold, strong c acid, but it dissolves readily in hot dilute c acid. When, therefore, I pour cold oil l over this ferrous sulphide, there is little tion, a film of ferrous sulphate forming on ace of the sulphide, and protecting the beneath from the action of the acid; but pour water into the containing vessel, a tion is at once set up, heat being developed admixture of the water with the acid, cold sulphuric acid being converted into hot ulphuric acid, which dissolves off the ferrous e as fast as it is formed.

now pass on to a consideration of some of ırities contained in natural waters—in water supplied to us for use in every-day life—ing, where that is possible, the sources and of contamination, and, further, discussing f precautions necessary for the removal of ıpurities as are prejudicial to the domestic of this valuable agent. First, then, we will r the gas found in solution in natural waters, me trifling exceptions, viz., some of the rarer l waters, the gases dissolved in water are which are present in our atmosphere—, nitrogen, carbonic acid, and ammonia. ygen and nitrogen gases, the elementary ıents of the atmosphere, are present in it riable quantities, and are far less soluble e other two.

carbonic acid and ammonia, or compound are chiefly products of animal life, and are constantly being removed by plants and vegetable organisms, but they are also more soluble in water than the first two. The carbonic acid is present in larger proportion than the ammonia, whilst it is also far less soluble than the latter gas. Indeed, after a long continued fall of rain, the presence of ammonia in the air of a place is hardly recogni- sable.

Spring-waters are very apt to contain much larger quantities of CO_2 than rain-water or river water. Meandering, as they frequently do, through subterranean passages, they are exposed in their course to influences peculiarly favourable to their conversion into strong solutions of this gas. The earth being the common receptacle for dead organic matter, and her cavities being in many cases never penetrated by the sun's rays, or ventilated in any way, accumulations of carbonic acid are to be ex- pected in these regions. The water, then, which is often very cold (it may be produced by melted snows), is churned up at frequent intervals along its course with these terrestrial gases, and becomes, in consequence, highly charged with them.

We are able to demonstrate the presence of dis- solved gases in water, by simply boiling it in an apparatus such as this which I now show you, and collecting the permanent gas which escapes, as is being done here. The presence of these dissolved gases in water appears to be in every way beneficial. If we consider water as a beverage, the sparkling and refreshing effect of spring-water is largely due to the dissolved gas, especially to the carbonic acid gas which it contains. Again, boiled or dis- tilled water, from which the gases have been ex- pelled by heat, is mawkish and insipid, but may be again rendered palatable by aërating it with charcoal. But more than this, absolutely gas-free water (which, however, can only be obtained by boiling water in vacuo), boils at a temperature considerably above 100°C., and with violent ex- plosion.

Again, it is probable that the oxygen dissolved in water oxidises, and removes some of the more readily putrescible organic matters contained therein; and it certainly is of the utmost import- ance to the life of fish. The dissolved gases in water also exert an important influence upon its solvent action for solids, as we shall now find. The solid substances dissolved in waters are generally chlorides, sulphates and, carbonates of the alkalies, and of the alkaline earth metals.

Those waters which contain the alkaline earths in solution, are divided into (1) calcareous and (2) magnesian waters, the former containing sulphate or carbonate of lime in solution, the latter sul- phate or carbonate of magnesia. Such waters are said to be hard. Now, it is in the case of the carbonated calcareous and magnesian waters that we observe most distinctly the influence which a dissolved gas may exert in modifying the solu- bility of a solid in their common solvent. For the carbonates of lime and magnesia are in- soluble in pure water, or nearly so; but con- siderable quantities of these salts may be brought into solution by water charged with carbonic acid gas. For instance, if I bubble carbonic acid gas through this clear lime-water, we first observe a milkiness, due to formation of the insoluble car- bonate of lime; and on continuing to pass the gas, we finally obtain a clear solution. The dissolved

gas enables the water to overcome the molecular sluggishness of the calcic carbonate, and to reduce it to the liquid condition; just as the dissolved ammonia gas in our previous experiment enabled the water to hold in solution the hydrated cupric oxide. Now, if I boil this clear solution of bicarbonate of lime, the excess of gas is expelled by the heat (just as the ammonia gas was expelled from its dissolving water when the temperature of the tube containing the solution was raised), and the water, no longer aided by the mobile carbonic acid gas, loses its power of keeping the calcic carbonate in the liquid state; accordingly that salt is reprecipitated.

Bearing the facts in mind, we shall be able to explain some of the phenomena of nature in connection with this subject of calcareous waters. We have seen that spring-waters are frequently highly charged with carbonic acid gas; now carbonate of lime, in the shape of chalk deposits and limestones of various kinds, is a very constant ingredient of the soil in many parts of the earth's surface. It must, therefore, be a matter of very frequent occurrence for water, already highly charged with carbonic acid gas, to come in contact with carbonate of lime in the course of its subterranean wanderings; hence the frequent contamination of natural waters with dissolved carbonate of lime. But there is another interesting and very beautiful phenomenon which we are enabled to explain by the light of the above facts. I mean the formation of stalactites and formations such as are figured in the diagram on the wall. Suppose a water holding in solution much carbonate of lime and carbonic acid gas to trickle slowly through the roof of a cave. From each drop of water, as soon as it finds itself exposed to the common air, some of its dissolved carbonic acid gas will begin to evaporate, and for each molecule of gas which thus leaves the water, a molecule of calcic carbonate will be deposited in the solid form. Let a few of these solid particles adhere to the roof of the cavern, and from the nucleus thus formed, the production of vast conical masses, such as are here pourtrayed with their beautiful tapering apices pointing towards the earth, is only a matter of time. The nature and quantity of the dissolved salts in spring water will, of course, vary with the composition of the soil through which it has passed. Many mineral waters are of great medicinal value.

We will next consider the influence of dissolved lime-salts upon the domestic utility of water. Is "hardness" in water prejudicial? If we consider the water as a beverage, the answer would be, No. The worst that hard waters have been accused of is that they produce a tendency to calculous formations in those who drink them. But I think the water-drinker may answer to that charge, "Not proven." And, on the other hand, we cannot but remember that the metals calcium and magnesium, in combination with phosphoric and carbonic acids, play the important part of conferring the requisite degree of hardness and stability to our frame—are, in fact, the earthy constituents of the skeleton. But there is another purpose for which water is employed, viz., for washing, and which is hardly less important than that we have just considered. For this purpose hard water is certainly disadvantageous.

Soap contains fatty acids, which form i compounds with the lime and magnesia waters, and no lather will be produced til lime and magnesia dissolved in the water h precipitated in this way. And this occ waste of soap.

Now, what is called the temporary har water may be removed by boiling it. Th sion of the dissolved carbonic acid gas means, leads to the removal of the calcic c from solution in the water, and the hard to that cause is then removed. But the w contain sulphate of lime in solution, which be removed by boiling the water. On the unless the water had been previously satur the salt, the evolution of steam in boilin rather tend to concentrate its solution, and permanent hardness due to this cause woul Moreover, there is a further objection t water (except in small quantities) for the of removing its hardnes, since, besides the tion of fuel which is necessarily incu deposited calcic carbonate tends to fo incrustations, often of considerable thickn the walls of the vessel employed for the and if they do not lead, as they have done, to dangerous accidents by their becoming detached, and producing explo of steam, by allowing the water to come with the strongly heated metal wall of yet must invariably cause great wast owing to their inferiority as conducto Therefore, the process of Mr. Clark, whi ducted without any application of heat a great boon to mankind, especially as additional advantage of clarifying a effectually as any filter.

The problem before us is essentially th may dissolved calcic (and magnesic) car best removed from solution in water? may these salts be converted into susp insoluble matter with the smallest possib piture of time and money? We have see method of boiling the water, though e objectionable on the score of expense, accidents, &c. Now, in Mr. Clark's proc I have said is preferable, the suspended calcic carbonate produced has to be re subsidence. There are two methods by pended matter is removed from water subsidence and filtration, and these pr also adopted by man for the same purpo it is claimed for the method of purificati tration that organic matters are oxidis substances employed, *e.g.*, charcoal, whi property of retaining oxygen gas in its p the process of Mr. Clark also undoubtedl dissolved organic matters from waters, which is added acting as a mordant, and their precipitation. Mr. Clark's process is —By adding quick lime or hydrated (sla to a carbonated calcareous water, the ca gas, which is holding the carbonate solution, is first removed by combinatio added lime, and the carbonate of produced falls, together with that pre solution, as a solid insoluble precipita turbid water is left to clear by subsid is afterwards drawn off freed from hardness.

ave hitherto been speaking of what may be unavoidable impurities in water — im-s, viz., which are introduced by natural es which are beyond the control of man; efore concluding, I must allude, however to a very important accidental source of ination of water, which is sometimes intro-by man himself, I mean the contamination r with lead. And here we shall find that sence of dissolved matters in any water is ly important in modifying its solvent upon this metal. Lead, from the ease hich it is worked, and the resistance it offers to atmospheric action, changes perature, &c., has been found to be onvenient metal wherewith to construct or conveyance of water, and cisterns storage. But lead is dissolved in ble quantities by some natural waters. long - continued ingestion of that even in very minute quantities, pro-ious symptoms of disease in the human so much so that the metal has given its at least two specific affections, lead colic palsy. It becomes, then, a matter of the mportance to be able to state, from a ge of the ingredients of any given water, or not it will be safe for persons to drink er after it has been stored in leaden -whether or not that particular water is exert any solvent action upon the metal. are able, in many cases, to do. For it found that pure water, free from olved solids and gases, has no solvent on lead. But water containing dissolved becomes impregnated with lead, oxide being, to a certain extent, soluble in

ctical Deduction:—Rain-water, stored in st not be used for drinking purposes. hen waters containing carbonates, and r sulphates, in solution are stored in cisterns, the metal becomes coated insoluble protecting film of carbonate hate of lead, further action being prevented, and the water does not become .

ctical Deduction:—Carbonated and sul-lcareous waters may usually be stored in impunity. The film which forms on the f the metal should by no means be re-

ters containing nitrates and chlorides in ce cannot safely be stored in leaden since the nitrate and chloride of lead are alts. The practical deduction from this is

cluding, I hope I have convinced most of ers that, though we do not drink pure would be very much worse for us if we that, whilst we may sometimes be inclined "Why is such a substance here?" we find at last that it serves some important which had escaped our ken—in fact, that nally led to wonder at the Wisdom which rough intricate and complicated labyrinths fect and simple end, and are forced to he ultimate tendency and result of even ming anomalies as the "impurities in

DISCUSSION.

The Chairman said, as his chemistry was of a very ancient date, he should not venture, in any remarks he might be bold enough to make, to discuss the chemical part of the subject. He had been exceedingly gratified by the lucid exposition of that part of the extensive subject which Mr. Johnson had selected, as well as by the well-devised experiments which had been performed, and which had brought out so fully the illustration of the principles laid before them. It was quite necessary to avoid, in a paper such as this, entering upon the extremely extensive and difficult part of the subject involved in the consideration of the organic impurities of water, as that could only satisfactorily be dealt with in a separate paper. A great part of his life had been divided between two residences, in which very opposite extremes in the condition of water existed, so that he had had an opportunity of observing, in a general way, the effects of these conditions. At Aberdeen he used the water of the Dee, which approached almost to distilled water, with the exception of course of the gases, and in Glasgow the water of Loch Katrine, which, was equally pure with the water of the Dee, and in both instances he was made aware of the circumstances which Mr. Johnson had so well explained with reference to the disadvantage that might arise from the purest water, more especially from the solution of the leaden pipes through which the water passed, or from the cistern in which it was kept. The introduction of slate cisterns must be considered a very great advantage, as they protected one against the risk, which might occur from keeping water for a long time in leaden cisterns. With respect to pipes, he was quite aware of the evil when they were new; and if the cistern was of slate, it was only necessary that the water should be run through the pipe a short time, in order to escape the danger which might arise from the water remaining a considerable time in the leaden pipes. He had known an instance of lead colic being produced simply from inattention to this precaution. He had also had ample experience of the process for softening water, for it so happened that the water supplied to the house in which he lived near Edinburgh was the hardest with which Professor Clark had ever come in contact. Few were aware of the evils belonging to extreme hardness of water. The water to which he referred, when used for boiling meat, had the effect of making it quite red; vegetables shrivelled up in a most wonderful way under its influence, kettles became encrusted, tea could not be made, and washing with it was quite out of the question. For the cure of this, by Dr. Clark's direction, he added a ninth part of lime water to the ordinary water, and during the night a subsidence, not only of the whole of the carbonate of lime, but of all the impurities took place, the water being then fit for domestic use. Those present must have been convinced by the author of the advantages which should belong to such impurities when occurring in a moderate degree, though they might not go to the length which the well-known old lady of St. Andrew's did, who, when great efforts had been made to introduce new water in the place of one which had not been favourably looked upon by the inhabitants before, said that she did not think much of the new water, as it had neither taste nor smell.

Mr. Lovegrove had been told that in nine cases out of ten water was contaminated in zinc cisterns, and it would be interesting to know the effect of water contaminated with zinc. A great deal had been said as to the impurity of water in daily use, and, therefore, he should like to know whether, supposing water passed through say 100 miles of iron pipes, the oxidation of the pipes would tend to improve or deteriorate the quality of the water.

Mr. Maignen said it was pleasant to find there was no great fear of mineral impurities in water doing much harm to the health of people. The germs of organic impurities caused disease, but lime did not do so except when in excess. The question of softening water was somewhat a cumbersome matter, and it might be egotism for him to speak upon the subject, as he had ventured to introduce a process to remove many impurities from water. The object of the process was to impregnate charcoal with lime, so that when the water was filtered through the charcoal, the lime in the charcoal took up the bicarbonate of lime in the hard water to a certain extent. This process could be carried on by filtration, and, through the kindness of Mr. Johnson, he had been allowed to put upon the table specimens of the filtering medium, and filters which he had patented. In the inside of the filter was a cone, the outside being covered with an asbestos bag, and charcoal being put into the water; upon its filtering, the bag became thinly coated with charcoal, which acted as an efficient filter.

Mr. Clements said that having paid some attention to the subject of impurities in water for the last few years, hefound there had been many cases of disease caused by water from sewers passing through the soil into wells; and some time ago he heard of a case which occurred at Croydon, where a man had been killed by drinking this impure water. There appeared to be a considerable discrepancy in the opinion of various persons as to finding out whether water was pure or not; and, some time ago, a gentleman in the South of London sank a well to obtain water, and having procured what appeared to be clear water, he gave some to him (Mr. Clements), and, upon testing it, he found it was very bad, as compared with the water supplied by the Kent and London companies. A great deal of discussion had taken place upon the subject of impurities in water lately, and much difference of opinion existed upon the matter.

Mr. Johnson, in reply, said that as regards contamination of water with zinc, he had no experience. He spoke with some diffidence upon such a subject, seeing so many distinguished medical men present, but from what he knew he did not think that zinc was a dangerous metal, it being frequently administered medicinally, nor could he say what action water containing impurities had upon zinc. As to water passing through a long iron pipe, there was no doubt the water would have a very considerable action upon the metal. The pipe would become corroded, and the water at the point of exit would be turbid, more especially with ferric oxide. He could not say, in an off-hand kind of way, that impurities in water were always beneficial, because, in considering the question of whether water would act upon any metal, it was not sufficient to say that the water was impure. We must always consider what the nature of the impurities is. Water which was impure with carbonates and sulphates was safe to store in lead, but, on the other hand, water full of nitrates and chlorides would be exceedingly dangerous to store in lead. As regards the action of the carbo-calcis filter referred to by Mr. Maignen, no doubt it was a very good plan for the rapid filtration of small quantities of water, but the great advantage of Clarke's process was seen when enormous quantities of water were required; for instance, in the case of large institutions, where soft water was necessary. As to the organic impurities in water, he had left that out of consideration altogether. He was quite aware that the commencement of his paper was somewhat elementary, but it was impossible to avoid introducing some elementary facts, and he thanked those who possessed knowledge upon the subject for having had patience with him while he touched upon those details.

A vote of thanks to the lecturer having been proposed by the Chairman, it was carried unani and the meeting adjourned.

INDIAN SECTION.

Friday, April 29, 1881; ANDREW C Member of the Council, in the chair.

The paper read was on—

THE BUILDING ARTS OF IN

By General Maclagan, R.E.

Everyone who has been in India l opportunity, at some time or other, of notice of the buildings in the places a he has had to take up his own abode fo He may, indeed, be often in places where not much to be seen. The ordinary dwe the people will not in India, more than el present much that will be thought worth ol Yet, even in the simplest of dwellings, see how much can be made of very slen resources, and how well, under the gu ancient custom and personal experience, turned to account.

When you hear of cottage walls made of word does not sound nice to English ea when you see them, you find they are s better than you thought. Put together s thickly, the mud becomes one mass th and, hardening as it dries, it forms a cor effective protection against heat and ag In greater mass, this simple material very efficient defensive works of what known as mud forts in India.

How simply, also, do we find roof supplied by a skilful use of the common grass that grow in the jungle (jungle observed, is the familiar name both for all uncultivated waste, which, except tracts, commonly becomes a wilderness and thorny trees and tall grasses). A r ing of reeds, of no great thickness, does afford much protection against the sur not exclude the heaviest rain; but i wonderful to see what it can do. At pl hills, you shall see local material of anc turned to account for roof covering, in and effective way; large flat slabs of e stone, doing duty as slates, with lumps o upon them to hold them in their place. as in most other countries, there is worth noticing in the way in which th of available means and materials are account in very simple ways.

In India, we notice next something mo we get above the very lowest and poores human habitations, we begin to see ma demand for some ornament. The orna be of a very rude character, but th Something is wanted more than that th shall serve its direct and essential purp may find ornamentation given in colour o carving. The white-washed door jambs streaks of ochre, diversified with curved spots, and sometimes more ambitious eff owner or the village artist. But there is of a higher class in the rough carvin lintels and the door-posts of houses in e

ending villages. Rough carvings, no doubt, often are, of simple waving lines or geo- patterns, after the fashion of greater and elaborate work in large cities. They are unsymmetrical, perhaps, and very uneven. dis is nothing; the eye does not care to be d in looking at these things. The ideas and are good, if the execution is sometimes rustic. or not, the effect is very pleasing. It admits iety of treatment, and the treatment rises to s degrees of excellence. But the great thing it is the expression of a felt desire for some- more than mere needs. A something pleasing eye has become a need, and it finds, in its way, on the spot, the art that is capable of ing the demand.

exactly similar application of this art of carving for external ornament is seen in the s most of the Indian rivers. In many of boats, of which there are numerous varieties y purposes, or for general traffic, there is a deck at the stern, which gives the steersman l-raised look-out, and command of the rudder, deck is also the roof of the little shelter of aily and the cooking place. The weather- g which edges this bit of deck on the side s the open body of the boat, presents a con- surface to be ornamented with this wood- . A real pleasure to people who have to e river boats, is this rude attempt at simple ion. The crossing of an Indian river, in se of a morning march, though sometimes s and troublesome business, is oftener a easing little break in the day's journey is when there is no unusual pressure, and are in their normal, undisturbed state. ou have stepped on board, and your horse persuaded to follow, you sit down to enjoy of quiet rest as you cross the steady, placid no sound meets the ear but the long splash big oars, the young day is fresh and cool, low sun glances on the smooth water. It peaceful and pleasant; and to all the quiet nt of the moment, it is something added this well-purposed effort of humble art a rough and hard-working, uncultivated It is the sign of a love for something pretty at—of a care for something more than is for the mere practical purposes of a safe stantial ferry boat.

ook with some satisfaction on these lowly, sing examples of unaided and unspoiled rt. Work of this kind, of all various de- f higher merit, in point both of construc- d ornamentation, will be found in the lass of private dwellings and shop fronts, in ys, verandah posts, latticed windows, and alconies, in the villages and towns, and nong the rude hill tribes, within and be- ur frontier. But we take our view of the g arts generally from works of a more ent character. We attach a higher value, in respects, to those that have stood the time; that is, we look to buildings erected our day, some of them very long ago.

e is often a sort of idea that one must go great way for specimens of excellence in arts, and, among these, the arts connected uilding. In India, as elsewhere, people een in the habit of saying that no such buildings are erected now, as in the days gone by, and that certain old arts are lost. It has been concluded that the capacity for such work has died out. It is one phase of the idea prevailing in all ages that former times were better. It may be the case that we cannot point to anything in India, built within the last hundred years, to equal the grand Hindu temples of Tanjore, the Jain buildings at Abú, the Taj Mahal at Agra, the Jama Masjid at Delhi. The occasion for erecting such buildings, and the means, are wanting. We are not warranted in adding, also, the ability to design and to execute them. It is almost need- less to say that for great and beautiful build- ings, great expenditure of money and labour is required. It was perhaps a stern necessity that stopped the second tower alongside the stately Kutb Minár at Delhi, and the second tomb opposite the Taj, and elsewhere left intended works un- finished. The ability was not wanting, but the means.

A wealthy prince, happily gifted with large ideas as well as despotic power, orders a work which shall be "exceeding magnifical," and it is done. The skill to plan, and the skill to execute, find full scope for all their highest ambitions. Materials are supplied without stint, of whatever kinds may be required, any number of labouring hands are collected from all quarters to order, and there is little question about cost. The will is there, and the command, and the means, and there is no hindrance. These are happy conditions for the execution of splendid works. If the work was to be a building of stately dimensions, of costly materials, and substantial construction, there you have it. For the master mind to devise and direct the whole was found with the occasion. Given the same conditions now, could India pro- duce such works? Doubtless it could, though the master minds, of the class required, would perhaps be cramped in these days by unwholesome in- fluences.

But besides the men, you must have suitable means to do anything really effective as well as lasting. Nothing great in building, or perhaps anything else, can be done cheaply. We remember Molière's niggardly old gentleman who wants to give an entertainment, but does not like the expense. "Can you give a good dinner for ten guests (or say eight, for what is enough for eight will do for ten)?" "Certainly," replies the *chef*, who knows him well, "if you give money enough." "There, now," says the miser's obsequi- ous friend, who is helping to make the arrange- ments, "was there ever a more absurd reply? A good dinner with plenty of money! Why any- body can do that. The clever man is one who can give a first-rate dinner that costs very little." Now this is a kind of thing that has sometimes been attempted with bricks and mortar; and with no better result than was to be looked for in Mons. Harpagon's dinner. If you try to make a cheap building that shall imitate a costly one, you need not be surprised if it turns out unsatisfactory, or something worse. Is anything of this kind done now-a-days by the English folks in India? Many an engineer has unhappy experiences in this way. With the money that can be granted for a certain work—and quite truly it may sometimes be impos- sible to add to it—he is to carry out something

which, done as it should be done, needs more; so he has to do it as it should not be done. "His poverty, but not his will, consents." And it is the ungracious task of those over him to aid in paring down what he would like to do. It really sometimes cannot be helped. The purpose is served, at least for a reasonable time. And, in that it has been served in the cheaper way, there is, so far, a ground of satisfaction. Only do not let us think that, as a piece of work, it is what it really is not. With supply of adequate means, very respectable work, to state it quietly, has been done by the English in India. Bombay has no need to be ashamed of being the place that has to receive most strangers on their first arrival. They are not made to lose, on coming ashore, the impression made on them when they steam into the beautiful bay.

If not many fine native buildings, either Hindu or Muhammadan, have been erected in our time in India, this may not mean anything more than that the occasions for erecting such buildings are rare, and the resources that can be devoted to them. But it may also, unfortunately, mean that the will of the person for whom the work is to be done has been exerted neither wisely nor well. Within recent years, the combined wealth and zeal of a prosperous Hindu banker have raised, at Mathra, a temple of no small pretension, which at least shows some capacity in the designer. The additions which some of the native princes have made to the buildings at their capitals have not been altogether unsuccessful, though it must be admitted that they have often allowed taste to be violated by the admission of extraneous art. There are, undoubtedly, evil influences of this kind at work, on many other arts and manufactures in India besides those belonging to building.

We might often be inclined to believe that native building power has gone out in other countries where it might be expected to live. Greece, nurtured by the traditions of the past, and taught by its visible inheritances still preserved to her, has done little in modern times to maintain her ancient reputation—very little, if her royal palace is to be an evidence of what she can do. Parthenons are not built now-a-days. We tried it, to be sure, some years ago, in Edinburgh. The money was only enough to build a dozen big pillars. And there they stand, on their proud and airy eminence. And among them, for many a winter and spring, have whistled the raw east winds from the Firth of Forth, which have long ago chilled down all the fervid enthusiasm for a great national monument in purest Attic art. But with plenty of money it would have been done; and with only a claim to good work, which it is, not to high power or originality. We are not looking for originality in India, any more than elsewhere, but for a right use of the art which has existed in days past. And we may be allowed to disbelieve the death of art in India, though, it must be admitted, many murderous attempts have been made upon it.

We are not fully able to say where the earliest building arts came from, of which we see the illustrations in India. There is nothing to show that any distinctive art of this kind was brought in by the intellectual race which, at a remote age, entered India from the north-west, and gradually extended southwards over their new country. There is to believe that they found architecture am people of the south. In whatever way a the Hindùs have shown a very admirable p forming a style, and working it with great of treatment, and great beauty of detail, the always equal soundness of construction. No reference is made by the historians of th invasion to fine buildings in India at th But the mention of Taxila as a great and ficent city, seems to tell of buildings at th that were of some importance. And now there only the ruins or traces of numero Buddhist topes; and a few other remain are undoubtedly Greek.

Muhammadan architecture, which came the West, assumed more graceful forms than it had done in Persia. It developed ot again when it travelled westward, and in Spain. Moreover, in India, it adopte time of the Emperor Akbar, and under the to some extent of his enlarged and liber Hindu forms of ornament, as well as of tion, in works distinctly Muhammadan, in a manner very effective and beautif similarly, in many parts of India, we fi buildings of recent centuries adopting, or less success, Muhammadan forms of tions, with corresponding ornament. Th appear to have something in commor fundamental ideas, which allows of the tions without marked fault. It is when we see Oriental forms trying Italian features, as at Lucknow, wher cases, the mistake is aggravated by th make a good show with inferior means.

The dome and arch, borrowed by son Hindu buildings, are foreign to pure Hi The construction was unknown to the ear builders. A well-known illustration of be seen in the great gateway of the Kutl at Delhi, built in the earliest Path The arch-shaped entrance is not an arc form is given by horizontal courses of s jecting one beyond another, till they would appear that Hindu workmen, un with the arch construction, were em execute the work to a prescribed arch f same thing is to be seen in a covere at the ruins of Ránigatt, a Buddhis monastery, a little beyond our Yusufza to the west of Torbéla on the Indus, ab Likewise in some old bridges in Orissa. pyramidal roofs of Hindu temples in th India have a dome-shaped crown, whi dome. It is scarcely necessary to say large Buddhist *topes*, the large buildin beehive shape, now pretty familar from and photographs, are not domes, but a on a solid core.

One of the most observable things in c with the best of the old Hindu build groups of buildings, is the attention tha paid to choice of site, and the admirable which the choice has been made. We a way in which English abbeys and monaste out lovely sheltered spots in which themselves, in green and peaceful vall own land. No less happy has been the the Hindus in the choice of situations

Temples, in shady glens and on
ll sides, have been placed where they
iful back-grounds of crag and forest, of
ır and cf varied foliage. Such are
Hindu buildings, small and large, in
dia and Southern India, in Rajputana,
:, and elsewhere.
:, one of the most noted places of pil-
ɔr all India, where so many thousands
on the 11th of April of each year, to
he sacred waters of the Ganges at the
hour, is built in a position to satisfy
timent and love of beauty together.
ver issues through the lower hills. And,
rthward, two little gaps in the next
ge show two bright snowy peaks away
d no more. To the eyes of the pilgrims
sources of the Ganges and the Jamna
ened out, as they flock to the sacred
ps, amid the temples of Hardwár.
arcely could a grander site be found
than that where stands the temple of
n Kashmir. Slightly raised above the
ain, it commands a truly magnificent
valley of the Jhelam, with its beautiful
g of snowy hills. It was no chance
at fixed upon this spot for the splendid
he Sun.
skilful has been the choice of the con-
ots on which, in the hill country, little
d other buildings have been erected.
on of the top of a hill may be simple
ne times, but it is not every hill-top
eased the Hindu temple builders, nor is
highest point that is taken. Any one
ade his way up to the temple of Chandi
he Ganges, or to Raja Hódi's castle at
, on the Indus, opposite Attok, or who
l the long stairs on stairs that lead to the
liman at Srinagar, and especially if he
hese ascents on a clear, bright morning
knows how well the builders have been
an eye that strove to be "satisfied with
hether looking up towards the building,
on its airy height, or down from it on
d far-spread scene below.
ny are the positions, well-chosen in like
little shrines on the western hills of the
d Sind, most of these being places which,
nough as it may seem, are resorted to
veneration by Hindus and Mussulmans.
where positions have been chosen as

iceable that Buddhist buildings, monas-
ples, and topes, or relic monuments, are
em built on the open plain, even in the
hood of better ground, with no reason
r apparent for the choice of their posi-
er buildings of the Buddhists occupy,
of the Hindus and the Muhammadans,
ng sites which seem to have been care-
ted. Some, at least, of those which
what we might be disposed to think
s are connected with incidents in the
life of Buddha, which may account for
position in which they are built. And
bably, have a similar history.
ere is often not much room for selection
sites in the wide-extended plains which
e principal no-feature of so large an amount of Indian scenery. Then in these plains the temple will often place itself in a dark shady grove, or under the shelter of a spreading pípal tree. Or the trees have been planted afterwards, to shelter the temple and its attendants. Again we may see how a fine position on a river bank has been taken advantage of, where a favouring bend of the stream gives a fair view in different directions. Situations of this kind are not without their inconvenience. A big Indian river, and, indeed, a small one too, is sometimes apt to be capricious, self-willed, and strong, and to assert its right to play with its banks in a way that is not good. Benares, Patna, and other places on the Ganges have suffered from this cause. When the British came into possession of the Punjab, the river Rávi was found to have cut away one corner of the large walled enclosure of the Emperor Jahángir's tomb at Shahdara, near Lahore. Protective works that were constructed up-stream succeeded in forming, as desired, a new broad bank, which defends the injured wall against further damage, and keeps the river at a distance. Similar measures have had to be taken in other instances, where buildings near river banks were threatened.

Our building predecessors in India did not meddle much with the large rivers. They had to build some defensive walls and terraces on their banks. Bridges, of course, they did not build across such rivers. Never till railways brought their demand for a continuous running line did the British Government attempt anything more than floating bridges on these rivers in the plains. And when we consider the character of the rivers, and the requirements of a permanent bridge, we have no reason to be surprised that even the wealthy Mughal princes and their engineers did not apply their strength and skill to works of this class, and were content, as their predecessors for many centuries had been, to use boats. The pier foundations of one of our railway bridges were scooped away by the stream, at a depth of 70 feet below the river bed. Another of these rivers, at a place where a railway crossing is being built at this present time, has been known to rise, in exceptional floods, upwards of 90 feet above its low-water level. We can feel, in the face of facts like these, that it was right to let the permanent bridges wait till the days of railroads.

Over swift and rocky rivers in the hill country, which it was necessary to cross by a single span, suspension bridges of hempen ropes or cables made of birch twigs have long been in use. On roads where laden cattle were used, something different was required for crossing the rivers. The kind of bridge called *sanga*, in the northern hills, is a good and useful construction, for which the materials were commonly available. A number of beams, laid side by side, project from each bank of the river, slightly pointing upwards, firmly secured by being built into the bank, and heavily laden at the shore end. Another set of beams is made, in like manner, to project beyond these, and others again till the space left in mid-stream can be crossed by single timbers. It is, in fact, like the overlapping stone construction. On cart roads, where something more is wanted, there are no masonry bridges in large single spans by native builders, such as have now been built in British times. It may be of interest to mention that a few years ago, two brick bridges,

each of a single arch, 140 feet span, were built (by Lieut.-Colonel James Browne, R.E.) over two of the rivers of the Kangra district in the Punjab, on the main line of cart road along that beautiful valley.

In the choice of their materials, we see much to admire in the works of the native builders who have gone before us in India. In the most lively times of Mughal building energy, the free outlay on grand works brought costly stone from long distances, and well has their white marble and red sandstone been turned to account. The most ordinary building materials, being such as the earth supplies, have been the same in all ages. The difference in their use, at different times and places, consists in the choice that is made of the better or the worse, and in the means available, in money or appliances, for conveying what was selected to the place where it was to be used.

When we speak of power to convey what was selected to the place where it was to be used, we observe that in India this power is not often illustrated, as in some other countries, by great buildings constructed of enormous stones. This does not seem to have been one of the favourite ambitions of the builders whose work is now to be found in India. There are, of course, big stones in some buildings, but their bigness is on a different scale from that adopted in other lands, and is not such as to give rise to the admiration which we feel in seeing what has been done elsewhere. There is a big trough at Vizianagar, in Southern India, cut out of a single stone between 30 and 40 feet in length, but it is probable that it has never been moved from the place where it was made. There is a temple in Kashmir which is built of five stones, one for each of the four corner piers, with its portion of roof, and the fifth a square pointed piece, which crowns it. But the whole building is not a quarter of the size of one of the big stones in the terrace wall of the temple at Baalbek.

The masonry of the outer enclosure walls and basements of certain Buddhist works in North-Western India, perhaps the oldest masonry now standing in that part of the country, is of a peculiar kind of effective roughness. It is without mortar. The large stones are unsquared. They have a tolerably flat face, but there has been no endeavour to make them fit each other. Between the stones are irregular gaps of varying width, which are filled in with pieces of slaty rock, all laid flat, and firmly driven home into these wide joints. There are many specimens of this kind of work in the Buddhist tract of the Punjab frontier districts.

There are likewise in India stone circles of upright blocks, like those well known in England and other countries. In one of these circles near the village of Asota, in Yusufzai, north east of Peshâwar, about 50 ft. in diameter, the stones have been roughly hewn on two sides. Their greatest thickness is about 2 ft., and the greatest height of any now standing is between 11 ft. and 12 ft.

It is remarkable how little (speaking generally) even the oldest buildings in India have suffered from exposure; and this exposure is sometimes of a very trying kind. The buildings bear testimony to the good choice that has been made of the stones used in them. A dark and hard blue limestone has been a favourite material with the Hindús. It receives fine sculpture, and retains sharp, well-defined edges. Much of the Buddhist sculptured work in the north-west of India, where sculpture is v dant, is on hard clay slate. The sculptur buildings is mostly on the interior faces. temples at Dilwara, on Mount Abú, prof beautifully carved inside, are of white Outside, these buildings are of studied pl not as the Hindu buildings, great and sm parts of India, which carry much ornam outside. The largest of these—the mag temples of Tanjore, Trichinopoli, Tin Madura, and other places in the south, of N the west, and of Orissa in the East—being throughout with elaborate carved ornam sculpture. On the hills of the Salt Rang Punjab (hills containing the great mines salt) are Hindu temples of a grey li naturally of a somewhat honey-combed which has suffered further from the weat

In the great imperial cities of the Mugh marble and red sandstone have been lar together, and with excellent effect. The polished, and well withstands the weat though it suffers little from the weather, another kind of injury, very subtle and some, to which it is exposed. However and closely the stones have been laid, ye joints between them, on domes and terr on cornices and parapets, the seeds of sl trees will find their way, and there begi and thrust their roots beneath. The pi particularly insidious in this kind of att watched stone-work, and if allowed to s see it has been sometimes, it will sl strongly, dislodge the stones, and, if the near the foot of the building, will pus roots through the wall, and down to moisture that it seeks.

In the Muhammadan buildings of A later reigns—the seventeenth centur latter half of the sixteenth—the red sa very largely used. There are buildings date, now six and seven centuries old this stone, frequently bearing Arabic i in raised letters, is still sharp-edged and contrasts very favourably in this re many buildings in England sadly d weathering of the sandstone. Oxford looks more venerable where the edges o are worn and rounded, and the form of t ings lost; but it would have been bet had not happened. There are buildin country of a sandstone much resemblin and general appearance that of the Mu in Northern India, but very different in The exposed masonry of the Church of S at Coventry, is seriously worn away, an be crumbling continuously now. In endeavour has been made to hold tog iron straps parts that were in danger of and in some of these places little mor iron strap now remains.

In the Indian buildings in which l marble and red sandstone are used, the colour is sometimes given by the use of ent materials for different parts of th sometimes by using them together, i bands, or otherwise combined. Colour shown in the Muhammadan buildings work in the piers of the arcades, the the arches, and other parts, and by lin

inlaid in the white. The inlaid work is ɔd on a large scale in some buildings. The chiefly used are blood-stone, carnelian, and · The inlaid work, besides that on the borders ıels and elsewhere in geometric figures, is representation of flowers in conventional and often with much freedom from the rigid stry which prevails in most Oriental designs. ptions in the Persian or Arabic characters ther inlaid or carved in raised letters, not ed like our inscriptions. In the interior of eat reception halls of imperial buildings, and re ornate private apartments, gilding also ıch used. But some of the most beautiful e Muhammadan buildings, are those in there is least colour or applied decoration of ıd, so elegant are the forms and so just the ions of the several parts, so refined the ngs, and so true the execution. One other of ornamental work of much beauty is ly to be observed in these buildings, the reen-work of open tracery—large thin slabs ble or sandstone, pierced with geometric of great variety. Very good specimens of d of work are to be seen in the Indian of the South Kensington Museum.

omparatively small variety of colour thinly on the outside of the Táj Mahal at Agra—an building perhaps best known in England cause of its having frequently been felt, at ht, to be heavy. It is not really unrelieved ty. Besides some inlaid coloured work, raight lines of black marble inlaid, black lines on the thin engaged pillars at the inlaid ornament following the outline of ıpets, and encircling the neck of the dome, aid inscriptions in large letters. But so e is the mass of white marble, that the us afforded is comparatively small. A little the building reconciles the spectator to this ness, and only leaves him full of wonder and with the beauty as well as grandeur of the g. Its surroundings are on a scale of corre-g magnificence. The great square en-with its splendid gateway, and the minarets orners; the straight-lined garden and its nasonry channels, with shallow stream of and rows of fountains in the middle; the lines of tall dark cypresses, with trees of aried foliage and colour throughout the ;—it is with these things about it, and a sense t stillness and solemnity over the whole, e look at this magnificent marble tomb. feel how large a measure of respect and de is due to the men who did all this, to ho purposed and devised a monument on ıle of grandeur, and those who executed it nner worthy of the conception. Have not on to be glad that the wealth of building n those days threw itself into forts and , mosques and tombs, pleasure gardens for , and serais for travellers? What should we e lost if Shah Jahán, for instance, had been e of smaller and more modest aims, and stowed the best efforts of his architects on d court-houses, town halls and barracks, ls and schools? Their time has come. s better for art, that Shah Jahán had his something else. The world has gained. fect of colour enhances the noble massive-ness of the *Táj*, we feel this to be in agreement with the nature and purpose of the building. The use of colour on Mughal buildings was well under-stood and very general. In the beautiful and wonderful city at the head of the Adriatic, which so many travellers to and from India have now-a-days an opportunity of seeing, we find a large amount of colouring of buildings, most of it very Oriental in character. But India has nothing to show of exactly the same kind. Buildings of brick, in India, if not faced with stone, were thickly plastered, and the colouring was given by figured designs, not whole surfaces of colour, or by a facing of glazed work, which is of two kinds, on pottery and on plaster.

The use of glazed tiles and glazed plaster seems in India to be most frequent in the western frontier provinces of Sind and the Punjab. But there are many good specimens at Gwalior, Delhi, and elsewhere, of buildings thus coloured. The work goes by the general name of *Káshí*. Glazed tiles are used when a large surface is to be uni-formly coloured. Patterns also of different colours are given on single tiles. The glazing on plaster is used for coloured devices, made up of separate small pieces, of the different colours. And these are laid on and cemented on the surface of the building. The plaster, which is made of lime and sand, receives first a very thin coating of glass containing lead, which both gives a fair smooth surface for the coloured glazing that is to be afterwards applied, and enables it to adhere. Both these arts seem to have been imported from Persia. The earliest specimens of glazed tile work known are at Mashad and Tabríz. The name Green Dome (*Sabz Gumbaz*) which is given to a conspicuous building at Mashhad, of which the city is proud, is also borne by a tomb at Lahore, of which the green covering of the dome is in good preservation. Another at Lahore is similarly called Blue Dome (*Lila Gumbaz.*) The cities of Multan in the Punjab, and Tatta, and Hyderabad in Sind, and others, have good speci-mens of this kind of work, as well as of the plaster *Káshí* work used for wall decorations and inscriptions. Lahore has many of great excel-lence and beauty, the most complete is the mosque of Wazir Khan, in the heart of the city. The figured tile work is now carried on in Sind, at Tatta, on the Indus, and at Hala, 30 miles north of Hyderabad. The Masjid, built by Shah Jahàn, at Tatta, has had the deficient tile work lately restored. At this place there is no glazed work of the other kind, that is, on inlaid pieces of plaster.

Indian brick-work, except in wells, is rarely seen, for it is always covered, or meant to be covered, in one of these ways. Its quality is excellent, though its appearance is coarse, as it was not meant to be seen. Well-burnt bricks are united by well made but rough mortar, the mortar courses being of great thickness, often much thicker than the bricks, giving the work the appearance almost of a concrete wall with thin bands of red brick. It is indeed a concrete. A similar material is used for terraced floors and roofs. And there are places where, the wood and tiles on which it was laid having decayed and fallen away, the terrace covering has remained, spanning the gap, as a single block of artificial stone or concrete bridge.

In stone buildings in various parts of the hill countries of India, the insertion of horizontal beams at intervals in the masonry, which is a common constructive arrangement, gives a pleasing variety to the outer face of the work, like the use of stone of different colours. The practice is similar to the use of bonding courses of red brickwork, which we see in Roman walls of stone masonry in Britain. This was well shown in the old wall lately discovered in extending the railway buildings in the neighbourhood of the Fenchurch-street Station. The bright red bands were of tiles or bricks of large size, of which there were three courses in each horizontal band. Similar bonding brickwork of bright colour is to be seen in a massive Roman wall at Leicester; of which English builders have taken advantage in a very practical way, by using part of the materials, both brick and stone, for the adjoining church of St. Nicholas. In the church the construction is repeated, stone masonry with courses of brick at intervals. The cathedral of Carlisle has in like manner helped itself to stone from a neighbouring Roman wall.

In these cases, as in many others, perhaps no great harm was done, as the walls were plain and uniform masses of solid masonry, interesting chiefly on account of their history and their construction, and having plenty of the work still left to satisfy this interest. But the practice is a dangerous one. It has been often followed, in all countries, and has sometimes not been quite so harmless. We cannot tell now what we have lost at old Delhi. Bernier says, Shah Jahan's new city, which was being built when he was there, was conveniently near the old one, which supplied quantities of building material ready for use. Very likely the honest intention in the first place was to take only the stones from absolute ruins. But we know how difficult it is to get any rule of this kind rigidly adhered to, and to prevent the despoiling of buildings which, if in a sense ruins, are yet ruins to be carefully and tenderly preserved. And these Mughals, though they showed admirable taste in their own works, felt no obligation to spare Hindú buildings on account of their beauty, even if they always respected those of the Pathans. Zealous Muhammadans, from time to time, have reckoned it no less praiseworthy because it was convenient, to destroy temples and other works of their idolatrous predecessors, though they did not often use the materials again on the spot in so pretty a piece of reconstruction as the colonnade at the Kutb, near Delhi. Muhammadan buildings, again, have been subjected to the same treatment. Ranjít Singh's marble *báradari*, or summer-house, in the palace gardens at Lahore, is certainly a very graceful building as it is, though rather too large for the enclosure in which it stands. But we cannot, therefore, excuse his robbing for this purpose the tomb of Jahangir at Shahdara.

Of a too indiscriminate freedom in using materials of old buildings, even English engineers in India have sometimes been accused. There are stories (Mr. Fergusson knows some of them) of English officers having turned to ignoble uses fragments which were of real worth and interest, and which, in time of pressing need, were appreciated only for their immediate usefulness. I am not prepared to say that such things have not been done, thou not myself know of any instances. The many places abundant supplies of old m particularly old bricks, which, being tak absolute ruins or worthless buildings plainest kind, or dug out from the found old towns and villages, can be freely used works. And this use of such materials give cause of unpleasantness to the tende science, or call forth remonstrance from protective antiquarian. But it has not been easy to draw the line, or make a contractor keep to it.

Besides defence of good buildings agai spoliation, protection against natural needed. Whatever have been the shortco the British Government, and the of British officers in India, in times past, wi to the care and preservation of old bui is not now to be said that the matter is The works which it is desirable to guard serve are in such number and of such size all can be done at once that is nee arrangements with this view have, for s past, been made more systematic, and now being brought more fully unde management. Everywhere attention is to the subject, and local measures are tak the progress of decay. Restoration is not except in some very special cases, but is made to preserve from further injury and the hand of man has spared, of buil we desire to save on account of their ar or historical interest.

India is generally believed to be which has been very stationary in certai many arts being practised in the san now as long ages ago. In regard to bui this is probably not more true of Indi other countries. Until the introductio we commonly understand by machinery, all ordinary building work was done fo part with hand tools, as very many done still, these common operations essentially the same everywhere. They in some particulars, as for instance, in some other countries, in the common feet for some parts of what we are acc call manual labour, and the practice of the ground for some kinds of work which artisans do standing. But, in the mair reason to believe the operations and the i to have been much the same for long in all countries alike which have com any such arts. Sculptures and pictu something of modes of working in anci and Assyria. Written accounts tell us than 2,500 years ago, in the land bet two, the smith with the tongs used to w coals, and fashion the hot iron with wielded with the strength of his arm carpenter stretched out his rule on t marking it with a line, then fitting it wi and applying the compasses; which brief inaptly describes the mode in which m same crafts work in all lands in the p The same may be said, no doubt, of t hewers who, three centuries earlier, Tyre to build the king's house at Jeru is when we come to see the scale on whi

ıewing work was done, without such helps as we have now, that we admire and persistent way in which immense d only by simple and primitive appli- used to overcome all difficulties in ıt a settled purpose. The labour ıon building works in India has not kind. We see that it was of a kind other qualities as high, always more direction of artistic feeling than of exert enormous power.

se old Indian buildings, sometimes a and sometimes not much, is to be m the people you find about them. mes know nothing that you want to ers will tell you a great deal which ıtter not put down as quite correct got it on the spot. But you may much from a humble informant that ıu to an understanding of the thing oking at. A deal of intelligence dge is often to be found under the ıge-brown costume, or the more simple white ashes. We can tolerate, for a is not attractive, when we find how is along with it that is better than it if we have learned something about ; that has engaged our attention, we better, and so is somebody else, for our It has drawn out something like regard to an object that has at least ɔn interest for the Indian fakir and the ristian. We have gained more than from the opportunity the old building chat with an unenlightened, perhaps, thless, fellow man. The sympathy, if ıd imperfect, quickens the desire for that shall be fuller and better.

few people who have spent years ıd have seen a good number of the f the people that were there before ave not brought away with them ıd pleasing conviction that these old re men who had a true knowledge of ɔnstructively good, and a true sense of rtistically beautiful. It is good that ɪs who go to India, and who care for , should know how much there is in ɪs of that country that will have an them. This is only one, however, of the classes of objects which India displays ks us to look at. I would not present it of the most important and most interest- ıany objects of interest and importance. ire rather to show that there is much ıat no one need want in India local nterest to engage some portion of his ttention. It is well, when the hands atisfaction of useful work, to find some nd us, apart from that work, whatever will pleasantly help to fill up some of ıours, and thereby lighten the hours of ays with the aid of recreations of some are quite as needful in India as else-

particular classes of objects are, to me is to turn his attention, depends on opportunities. It can seldom be that will not yield something. To one, ɔwn products, in the garden and the field, on the hill and the plain, supply unfailing sources of study and enjoyment. To another, the investigation of the earth itself. To another, the field sports of India afford the means of seeing and knowing many more things, besides the creatures which are the objects of the chase. One in the languages and literature of India finds ample material for profitable research; another in the arts and manufactures; another in the history and antiquities; another in free intercourse with the people and the study of their local dialects, their personal and social customs, their traditions and stories, their proverbs, and their songs. In all these ways one learns to know also something of the thoughts of the people, their feelings, and their wants; and, let me add here, always in so doing, learns to think more kindly of them. This, and much more there is, in the records of the past, the life of the present, and the needs of the future, to supply matter of deepest interest to every English sojourner in India.

It is needful sometimes to notice this, for there are some people who cannot believe there is any- thing in India in which they could manage to get up an interest, or which could help to reconcile them to the country. They make up their minds there is nothing there for them to like or care for, and a great deal to object to. And there are things to object to. An English traveller of the early part of the seventeenth century, the chaplain of Sir Thomas Roe's mission from James I. to the Emperor Jahángir, devotes a chapter of his book to what he calls the "discommodities, inconveniences, and annoyances, that are to be found or met withal in this empire." And he goes on to tell of them in detail. There have been many improvements since Edward Terry was in India, but "discommodities" and "inconveniences" there are still. Snakes and scorpions have not been abolished, though, indeed, you do not see them so often as some people have supposed; there are still mosquitos and sandflies, as well as other small insects; there are musk rats and white ants; there are dreary wastes and dirty dust-storms. And it is sometimes very warm in India. Yet, somehow or other, with all these things and many more, it is not a bad country after all, and, as Terry himself properly adds at end of his chapter, there are also "commodities and contentments to be found in those parts."

Much of what we now find to delight us has been created since his time. Akbar's grand administration was then over. Shah Jahán's magnificence was yet to come. The two centuries that have gone by since his day, have made a great difference to us, and to the people of India, and have greatly helped forward the knowledge of many of the things of interest I have referred to, which present themselves to us in the present day. I do not press the claims of any one above another. Each has its interest, and will get people to care for it. Whatever the line each person may take, who cares to give attention to his surroundings in India, all I am concerned here to say is,—don't forget sometimes to look at the old buildings.

DISCUSSION.

Mr. B. Haughton, C.E., said that on a previous occasion he had mentioned in that room the Taj Mahal

as being the work of Indian architects, and brought it forward as an instance of the extraordinary architectural capacities of the people of India, whereupon he was contradicted, and told that the Taj was built by Italian architects. He should be obliged if General Maclagan would give his opinion on this point. He had since consulted the Encyclopædia of Larousse, in the British Museum, in which it was stated that the Taj Mahal was a marvel of Indian art, that it was built by Shah Jehan, in honour of his wife; that it consisted principally of white marble, was commenced in 1631, occupied 20,000 workmen, that the marble was brought a distance of 200 or 300 miles, and that the expense was 80 million francs; it was also stated that some persons pretended that a Frenchman, known in India as "the marvel of the age," laid claim to the paternity of this *chef-d'œuvre*, which had not a rival in the world. He had been much struck with General Maclagan's description of the thin brickwork, with a thick layer of mortar between, so different to the mode of building in Egypt. He had tried in vain to insert the blade of a penknife in the joints of masonry in the pyramid of Cheops. He had roughly calculated that the large stone in the ruins of Baalbeck spoken of, must have weighed about 800 tons. They were accustomed to large stones in Egyptian buildings, and other ancient ruins, as, for instance, those at Tadmor. It was very satisfactory to hear that the specimens which had been produced were not taken from actual buildings; but, unfortunately, a different spirit sometimes prevailed, for he had seen large pieces knocked off the Cleopatra's Needle now at Alexandria, with a geological hammer.

General Maclagan said it had been ascribed to European architects, and the question had been much discussed, but opinions were most in favour of the conclusion that the Taj Mahal was a purely Oriental construction. He should have a very high opinion of the French architect who had designed and constructed such a building. With regard to the style of the masonry, he observed that stonework in India was quite as fine as that in Egypt; it was only brickwork that was laid with such thickness of mortar as he had mentioned. The habit of Englishmen and others of bringing away specimens of anything remarkable or interesting was very general, and he could quite believe what had been said about pieces being chipped off Cleopatra's Needle, for where it lay many years, half buried in the sand, it presented tempting facilities to visitors of this class. Some travellers left their mark without taking anything away, and at Baalbeck, on the building containing the magnificent stones he had mentioned, he had seen names painted in letters a foot or fifteen inches high.

Mr. Thornton C.B., said he thought he could clear up the question about the architecture of the Taj. In the itinerary of Manrique, a Spanish monk, who lived some time in India, in the time of the Shah Jehan, it was mentioned as then being built under the supervision of an Italian architect, named Geromino Veroneo. He stated that Geromino was asked by the Emperor to make an estimate for the construction of Taj, and accordingly, with the help of native architects, he made an estimate, and gave the cost at 3 lacs. The Emperor said that would never do, he could not have a building of that cheap description, whereupon Geromino retired, and after a time produced an amended estimate of 19 lacs, which was eventually accepted. This Geromino Veroneo was afterwards sent to Lahore, probably to superintend some works there, and there he died. With reference to the art called Kashí—the coloured tiles, which formed so prominent a feature in so many buildings at Lahore—there is a tradition there that it was introduced by the Moguls from China, originally through the influence of one of Timour's wives, who was Chinese. The word "Kashí," he was told by those conversant with the subject, wa from an Arabic word, signifying a porcelain

Mr. W. Simpson said that the last speaker h so far an explanation about the building of that there were foreign architects who engaged on the work; but he believed when went to Agra, Veroneo was dead, and the been then taken up by another Italian, nam Full information on these points would be f small article, by Judge Keene, in the 11t new series, of the "Asiatic Researches."

Mr. Thornton said he had supplied Mr. I the information.

Mr. W. Simpson said it had been generally that a Frenchman, Austin de Bordeaux, had nected with the Taj, but he supposed that t Manrique had settled the point as to the e European art on that structure. He (Mr visited the Taj in 1860; at that time the qu been mooted, but he had no need to look fo information as to whether it was the work architect, for foreign art was written on it as palpably as could be. He had no doul saw the ornaments, the inlaid work in the s well as in other parts of the building, t artists had been at work upon it. It was s at the building of the Taj, that this Flor of ornament came to India, and it had rem ever since. The design of the Taj was similar to other designs of Mahommeda India. He could not give to the Taj the which some did; it seemed to him to be decadence of Mahommedan architecture, you came down to the stage which at p be seen in Lucknow, where it became si and plaster, and ceased to be worthy of architecture. The Taj was not to be c real art with the older work about Delh sidered that Indian Mahommedan archite almost with Akbhar; it was at this ti Mahommedan had combined in a most beau Hindoo forms with his own, and then foreign European style, which never amalg the Indian, and the Indian art descended state it was now in at Lucknow. He had very great pleasure indeed to General Macla especially as he had been to nearly all th had mentioned. He had ferried across a morning such as had been described, and the picturesque boats. He had crossed t Bridge on the Sutlej, which was similiar described by General Maclagan, and had bridges of rope, and had drawn the pecu the old Musjid at Delhi, to which referen made. To know the building arts of Indi have travelled in India, which he had had of doing, so as to realise the amount of bui had been done in that country in the past. there were about 40 square miles of ruins. wandered about sketching them, he thought medans were really the great men of Indi went the next cold season into Rajpootana upon the old city of Chitoregurh, the ancie Mewar, where there were ruins about three and a mile wide, of the old city which t left when it was sacked by the Mahommed had remained ever since, and it was certa wonderful place, and since seeing it, he doubt Mahommedans were the greatest of Indian They were certainly great, and the ruine Delhi were undoubtedly the most beautif remains. There were many other places wh of buildings were found. On the site of was said you could not dig for twenty mile without coming upon bricks, which would idea of the extent of the ancient towns. In

re ground, the Archæological Survey hing some of the old cities. He might n, that there was no country in Europe, ; of the world, to compare with India l building remains.

thought that, in their enthusiasm for must not be too hard on the present for not producing works of a similar k the cost of the Taj at three millions ıpared that with the amount of money this more utilitarian age—for railways, results to show. We had spent about ing on railways alone in India, which t 40 Tajs; and, besides that, there r works of utility, such as irrigation, een constructed.

ayrer had listened with very great paper, as it revived the charming his 22 years' residence in India, and idly many of the most distinct features Many people, talking about India, said ng to be seen there, and he was very l Maclagan had read this paper, which acy of such a statement. When one rand ruins of Old Delhi and the Kutub, uins at Agra, part of which there were served in the fort; or the old city of where there were certainly some very ed sandstone; or the beautiful carved n in many places, mostly of the time of bsurd to say there was nothing to be One thing had impressed him very ft the North-West Provinces and went was that the art of constructive build- ceased with the Mohammedan Empire. t Lucknow were, for the most part, tures in comparison, consisting of and brickwork. With regard to the thought he had seen somewhere that ted by native builders, although an designed it; but he believed the truth ecorative work, the inlaying, carving, , whilst the main design of the building

nge, V.C., C.S.I., wished to make one er to an observation made by General which had also been referred to by nan, that since the English rule in es had constructed no important new this undoubted fact was often put reproach to the English Govern- ught, however, that this was not a make. Before the English rule was dia, it was impossible for anyone above mmon cultivator of the soil to live in an life was not secure enough, and the isrule of the country, were forced into and when they congregated there it was y should wish to distinguish themselves ples or mosques, or tombs. But when as established, in proportion to the afety of the people, they left the cities the country, to occupy themselves in lture, in a way they had not been able three centuries before. He had on two ities become nearly depopulated, but he rtain that it was caused by the prosperity t large.

agan, in reply, said there was no doubt el Keatinge had said was, to a great He had said in the paper that, except in a the occasion for erecting grand build- , and also the means available to be them. There were some beautiful Sir Joseph Fayrer had observed, at Fattehpûr Sikri, built with large stones, and there were large stones in many buildings in India; but their size was on a scale very different from those at Baalbek, the great arch in Jerusalem, and other places. He agreed very much with what Mr. Simpson had said with regard to the change in the style of architecture after Akbar's time. The builders of his day adopted Hindoo forms with remarkable success. There were some specimens of pillars, corbels, brackets, &c., of Akbar's time in the Indian branch of the South Kensington Museum, which were of great beauty, and would show exactly what Mr. Simpson referred to. There was a certain massiveness about the architecture of that time, which he quite agreed you did not find afterwards. Still, the beauty of such a building of later days as Jama Masjid, at Delhi, the elegance of form, and proportion of the domes, the minarets, and cupolas, and other parts, was undeniable. He had with him some photos, in which the beauty of the details of build- ings mentioned by Mr. Simpson was remarkably shown. Mr. Simpson had observed these things probably with more attention than any gentleman in the room, and the results of his observations were of much value.

The Chairman then proposed a vote of thanks to General Maclagan for his admirable paper, which was carried unanimously.

NINETEENTH ORDINARY MEETING.

Wednesday, May 4th, 1881; Lord ALFRED S. CHURCHILL, in the chair.

The following candidates were proposed for election as members of the Society:—

Bonar, Lionel Ninian, 75½, Old Broad-street, E.C.
Butler, Lieut.-Col. Henry Thomas, 66, Prince's-gate, S.W.
Campbell-Walker, Capt. Arthur, Ashley Warren, Walton-on-Thames.
Gibbs, Sir B. T. Brandreth, 13, Pelham-crescent, South Kensington, S.W.
Hudleston, Wilfrid H., M.A., F.C.S., F.G.S., 23, Cheyne-walk, Chelsea, S.W.
Lee, Charles John, Fairlight-villa, Sydenham-road, Croydon.
Nesbit, A. Anthony, F.C.S., 38, Gracechurch-street, E.C.
Nevill, Lady Dorothy, 45, Charles-street, Berkeley-square, W.
Stirrat, Robert B., 7, Grey-street, New stle-on-Tyne.
Walkinshaw, William, Hartley-grang , Winchfield, Hants.

The following candidates were balloted for, and duly elected members of the Society:—

Beattie, William, London and South Western Railway Works, Nine-elms, S.W.
Cockburn, James, 11, Heathcote-street, Mecklenburgh-square, W.C.
Crossley, John Thomas, Q.C., 91, Cheyne-walk, S.W.; 4, New-square, W.C.; and Junior Athenæum Club, S.W.
Gibson, Joseph F., Clovelly, Woodchurch-road, West Hampstead, N.W.
Goodwin, Thomas, 12, Southwark-street, S.E.
Law, James, 544, Oxford-street, W.
Lovett, William John, Carver-street Works, Birming-ham.
Lyell, Francis Horner, F.R.G.S., Nettlestone, Widmore, Bickley, Kent.

MacGregor, Alexander, M.A., 6, Charles-street, Berkeley-square, W.
Powell, Frederick, F.R.G.S., Bakewell, Derbyshire.
Pupikofer, Oscar, 28, Finsbury-square, E.C.
Stubbs, William Henry, 3, Winton-square, Stoke-on-Trent.

The paper read was—

BUYING AND SELLING: ITS NATURE AND ITS TOOLS.

By Professor Bonamy Price, M.A.

Buying and selling are matters so plain, that it almost seems idle to ask what they are. They are things done by everybody every day. Yet in the practical world, the most familiar things, though they may have the greatest importance for human life, are often the least understood. They are the very region where confusion and mischief dwell.

Look, for instance, at the different senses given to the word money, and the power which the ideas attached to it exercise over human life. Yet how many can answer—What is money? and how is it that it buys?

First of all, let us inquire whence came buying and selling? How is it that they are so universal amongst human beings? They spring from the most peculiar and characteristic feature, the greatest power of civilised life, division of employments. I will make this for you, if you will make that for me, is the basis of civilised existence, is the root of all progress. Hence it is that exchange is the very core of political economy. Division of employments enables each man and people to perform that work for which each of them has a special aptitude. It creates skill, developes machinery, obtains larger and better results from the same labour, then reduces the cost at which they are made, and consequently vastly diminishes price. By dividing out the work to be done amongst each other, mankind acquires more wealth and finer quality at the end of the day's work.

The first consequence of division of employments was barter. But a most embarrassing difficulty immediately presented itself. How could the men who mutually wanted each other's goods be brought together for exchanging? On a large scale, as society developed itself, and employments grew in number and distance, that was impossible. How could a farmer have found a tailor who would give him a coat, or a shoemaker who would give him boots, in exchange for a calf or a sheep? What could the tailor have done with the calf? Exchange would have stuck fast, and only a petty village life would have been possible, The difficulty was solved, and civilisation won, by Indians. They invented money, a money made of skins. The perplexity vanished. The career of trade was opened for the human race. The mighty machinery of division of employments was established.

The savages invented a true money. They consented (to use the language of city men) to buy and sell with skins, and these skins tell us what money is, and how it works. The skins were commodious pieces of wealth, useful, and consequently valuable. They cost labour to produce, and that gave them worth as against other articles. The trouble of the day's chase, the food it co value to the skins. The skins would not cured, much less given away, without co tion; in economical language, they p value—value in a market, value in exchan instinct of the Indians made them willing skins as money. Each man knew that al would take them in turn as money. Th was always sure of getting food in exch them. Every man who took them coul pleased—just as the gold of a sovereign moment make them cease to be money, them as things for use. The skins reveal th mental truth, so generally unperceived nature and the working of money. It i an instrument, a machine—absolutely else. There is no fact about money of m portance to grasp than this, simple and though it seems to be. These skins taken to be worn; they were intended to about from man to man, for working as t this peculiarity, that they could do work for each man. That is what is meant lating. This is precisely what a soverei does. It is a pure tool, of no other use so long as it remains a sovereign, and is r If only bankers and merchants would s minds to be penetrated with this truth, coined as money, is an idle, useless thin does work as currency. The skins wore handling; so does a sovereign, but whe it has performed services well worth th out. The sovereign does nothing else in but pass from hand to hand, precisely or a locomotive are worthless things, u perform the work for which they were i

Now we can answer the great questio city finds so hard to answer—How is sovereign buys a hat? You cannot pay attention to the answer, perfectly simpl be. It buys because it costs as much expense of carriage to bring that small pi from an Australian mine as it costs materials for a hat, and to manufactur a hat. The whole mystery of money once. There is no better money than a The gold buys by means of its cost of p certainly not, as so many have said, b its stamp as a coin. The stamp only sh is made of good metal of the right we hatter sells for a sovereign, because, in th of Aristotle, he knows it to be a useful c He gives away the hat for a piece of which he can convert the sovereign, if precisely as the Indian might take th bought into wearing. He relies on th the metal, that gives him the assuran important assurance, that other sellers him goods of the same value as his hat, will give him articles worth the met sovereign, that is, worth his hat. It i which buys; the word money is not nee plain the fact. That this is so, is pro daily fact that nations pay their trade b each other in bullion; they are willing with the amount of uncoined metal co the money due.

But though skins are real money, a the true nature and mode of working still they are not good money. They are

fast, are of uncertain supply and value. ıe best material yet known to make this It is hard, pleasant to handle, very light value, divisible into parts, can be re- ıck into a commodity easily, and, above the greatest of qualities for serving as steadiness of value. For the innumerable l investments expressed in money which ise modern life, the payment of the same was estimated at the time when the debt e, is of the most supreme importance. It held by many that gold itself has become but it has never been definitely proved. ls for discussing this most complicated

w can see clearly that an act of buying is f barter, the substitution of double for rter. The sovereign is first bartered for nd is re-bartered by the hatter for an . They have been exchanged by the f the tool money. Further, money the means of measuring the values of ies against each other. All have their noney. Thus the value of a £30 gun is be 30 times greater than the value of a e convenience of such measurement is .

ention must be drawn here to a fact of ıificance; good money works by the cost tion of the metal it is composed of; but s of many articles are determined by ces besides cost of production. That ıys be given; but a power often comes which varies price, expressed by the ıe in the sense derived from the verb, I ; is a feeling, and is the greatest force litical economy. It denotes the esteem felt for an object, the amount of caring e power which determines how great is ; which a buyer is ready to make to t, how large the compensation which iven to a seller for the sacrifice of parting This feeling is attached to every article ut to many it adds a price far higher ost of production. A Raffaelle picture, ce, an old marble, a distinguished auto- d the like, sell for immense prices, de- on feeling more or less fanciful. They ake excessively bad money. A buyer given £10,000 for a Michael Angelo, ve no security that he could change it ls for anything like that value. Ordinary oduction is a determinate quantity, and ıe for all. It thus can increase all value, dependent on feeling or other.

rdinal fact, that money—a sovereign—is d a tool only, is full of instruction. In lace, it kills off the mercantile theory that ve to hear, that exports ought to exceed A more foolish idea cannot be imagined. denotes that the goods of the traders ; sold, and there they stop. If only get hold of the money, they ask questions; they feel that they can now what to do with it; they can buy y like. But is the country the richer for se of coin? Could these good people ght less, if they had been paid with stead of money? Is a farmer the richer, ; him to have as many carts as he wants, if he is paid for his wheat in carts? Oh, but a farmer could not get rid of his excess of carts easily; there is no trouble in buying with money, if only the money is in hand. But what becomes of the money thus acquired by an excess of exports? The answer to this question depends on another. How many coins, how much gold, does a nation require, and is able to use? The answer for money is the same as for carts or hats. How many hats does England require? Clearly as many as there are heads, and a few to spare. What, then, is the thing which corresponds for coins, as heads for hats? Plainly, the buying and selling carried on by coins, including those needed for banking reserves. There must be currency to perform that work fully, else great inconvenience would arise—some to spare would also be advisable against unforseen contingencies. Beyond this quantity the tools are useless: they have nothing to do; then what becomes of them when brought in by an excess of exports? So long as they remain in England, they are locked up in the Bank of England's vaults: they are wealth for the time annihilated. Meanwhile, how has it fared with England in respect of the exports for which there is so much rejoicing? They consumed a vast amount of wealth in making: food and clothing for labourers were used up, coals were burnt in profusion, materials worked up, and all is gone. What has England in return? some metal locked up in cellars. As long as it remains in England, she is the poorer for these exports. The wealth returns only when the buried gold goes abroad to buy, and then the imports will exceed the exports, and the country is made the richer. Imports alone enrich a country, not exports. To buy gold which cannot be used is as pure an impoverishment for the time, as if the purchasing goods had been given away for nothing. The question always is—Is it worth while to buy this unneeded gold?

We now pass on to paper money—bank-notes. Time fails to examine this form of currency in detail. I will only remark—

1. That there is a large gain to the country by substituting for sovereigns tools costing sixpence for doing the same work.

2. But how is it that paper can do the work, if it be true that money works by double barter, giving value for value? Is this view unsound? Not so. The explanation is to be found in the fact that a sovereign works, not by using the metal of which it is composed, but by the value which it possesses. If twenty persons receive the same sovereign on the same day, each has had the worth of the goods he sold, but the sovereign remained unchanged. Each seller knew that he could melt that sovereign into gold metal and barter it as such, but he did not. The knowledge that he could do so sufficed. Hence, if the sovereign had been placed in a kind of cloak-room, and the ticket received for it had circulated in its stead, the work of exchanging would have been effected equally well by the paper tool. The ticket gave the power of obtaining the metal when desired; that sufficed for each seller.

3. This shows the extreme importance of the sovereign being at hand when demanded. Inconvertible bank-notes are a bad money. They are sure to be issued in excess of what the country wants for buying with. Their value

then becomes depreciated, and very variable. The relations between debtors and creditors, between shop-keepers and their goods, become vitiated, to the great injury and loss of the whole country.

We have now reached the third great instrument of buying and selling—banking. To show its vast importance and power, it is enough to say that payments exceeding 100 millions of pounds are made in the City every week by the Clearing-house, without a penny of money being used. On no other subject connected with trade does such deplorable confusion exist as on banking. What, then, is a bank? a question which few indeed know how to answer. It is an intermediate agency between a lender and a borrower. A banker is best understood if looked upon as a broker between two principals. He brings them together, just like a stock or corn-broker. With what he receives from his customers he first pays the orders for money which that customer makes upon him with pieces of paper called cheques; the remainder he transfers to a borrower. Does he make those payments with money? Does a banker deal in money? Most certainly not. One fact is conclusive on this point, besides the evidence of the Clearing-house. Sir John Lubbock has shown that only three pounds in every hundred were received by the great banking-house of Robarts in cash, and of those three pounds, ten shillings only were money, metallic money. How can a banker pay £100 with only £3 of cash? He does not, and cannot pay the remaining £97 with money. This fact is decisive—a bank does not deal in money, does not receive or pay money, if the word money is to retain its real meaning. How then are the £97 repaid to the depositor? Here lies the secret of all banking. To understand this is to understand banking. Let us consider a complete banking transaction from its origin. A farmer has sold £1,000 worth of corn, and is paid with a cheque, say on Glyn. He places that cheque to the credit of his account, say at Smiths'. How do Smiths obtain payment of this order for money? By asking Glyn for sovereigns? Nothing of the kind. They send it at once to the Clearing-house. This is an office to which the City bankers send the cheques which they have to receive from each other. Every two hours a list is made out for each banker of what he has to receive, or has to pay on the cheques sent in; he settles the balance by receiving or giving a cheque for it on the Bank of England. The Clearing-house acts precisely as a player at cards, who puts down what each man wins or loses on each game. No money passes all the evening; at the end of the playing each man pays or receives the balance which he has lost or won. At the Clearing-house not a sovereign passes, yet a hundred millions of pounds and more are paid and received every week. The debts and payments are settled simply by new items entered in new lines in all the banking books of all the banks. Is this dealing in money, when no money is touched? Is it anything more than machinery for creating and sweeping away debts? But let us proceed further. After the farmer's cheque has been received by Smiths, a borrower, who wishes to buy cotton, comes in, and asks for a loan of Smiths, his bankers. They bid him go and buy £70[illegible] of cotton, and pay for it by drawing a ch[illegible] themselves. The cotton is bought and pai[illegible] a cheque on Smiths', which is lodged wit[illegible] the cotton-dealer's banker. This second c[illegible] in turn sent by Glyn to the Clearing-ho[illegible] meets the cheque of £1.000 which Glyn ha[illegible] to the farmer; Glyn, if no other chequ[illegible] turns up, has to pay the difference of £30[illegible] he does by a cheque on the Bank of Englan[illegible] the whole banking transaction is ended. [illegible] has happened? First, not a shilling has [illegible] Secondly, the farmer has enabled his [illegible] Smiths to buy; his power to buy they ha[illegible] ferred to a cotton buyer. Thirdly, corn [illegible] exchanged for cotton; the remaining £[illegible] been transferred to Smiths' account at th[illegible] England. Smiths do not lend the whole [illegible] the farmer's cheque, £1,000, to the cott[illegible] for they know that he will buy things whi[illegible] want, and they reserve £300 for these p[illegible] Thus we see the essence of bankin[illegible] machinery for exchanging goods. The g[illegible] chased pay for each other by means of [illegible] paper registered in ledgers. Thus ban[illegible] magnificent tool for buying and selling [illegible] the work fully, yet, even reckoning notes [illegible] it saves the necessity of buying and e[illegible] £97 of currency. Trade thus gains enor[illegible] simplicity and cheapness.

But here the intricacy and danger i[illegible] present themselves. The banker has len[illegible] purchasing power belonging to the f[illegible] whom he has found a borrower in t[illegible] merchant. But the farmer retains th[illegible] demanding his £700 when he pleases, [illegible] cotton merchant may have borrowed on [illegible] three months, or may have failed, and [illegible] to repay his loan. These uncertainti[illegible] exist. They call upon the banker to [illegible] habits of his depositors, and the busin[illegible] traders to whom he lends what does not [illegible] him. These examinations cannot be made [illegible] fect accuracy; and the bank may fall in [illegible] some day. Hence arises the necess[illegible] reserve—that is, a sum to be retain[illegible] bank, beyond what it lends, to gua[illegible] contingencies. This reserve, being the [illegible] between the banker's deposits and [illegible] will necessarily take the form of cash, [illegible] notes. That reserve will vary accordi[illegible] vicissitudes of business; its fitting am[illegible] depend, as a rule, on the judgment of t[illegible] according to the signs of the commercia[illegible] The danger of the bank coming to a s[illegible] never absolutely absent; often it may [illegible] comfortably near. The banker's profit [illegible] a charge on the loans he grants, called [illegible] When danger threatens, he raises this rate [illegible] or discount, which diminishes borrowing, [illegible] many who have previously borrowed [illegible] repay their loans. The moral which t[illegible] teach is plainly this—that he should [illegible] watch and study what is going on in b[illegible] around him; how far it is safely cond[illegible] earning profits; what is the commercia[illegible] of his own and other countries; what f[illegible] be at work diminishing the wealth of t[illegible] what is the position of particular trades [illegible] vidual firms; what risk there may be of [illegible]

nerate a panic and create a run of on banks for the repayment of their This is the law of right and safe bankion in which the thoughts and study of should live. By such vigilance banking rational. Such a banker in America, risis of 1873, would have seen that the ople were rapidly involving themselves y their excessive construction of fixed out on some 30,000 miles of new railwould have known that labourers were ood and clothing, coals prodigiously making iron and machinery, and that on of all this wealth thus destroyed effected by the railways under twenty ars. The nation must be poor, and and commercial houses failed, and what they had borrowed from banks. banking might have prevented the s, and its effect on the whole coml.

counter, face to face, the most startt astonishing intellectual phenomenon world. What commercial profession has tion for intelligence, for ability, for the range and intricacies of business. banker? Yet that great profession a delusion, an ignorance of the nature , of what it really is, unknown to any of trade. It would be most prend unbecoming in me to use such I stood alone; but what I have years, I have had the advantage of own to the very dregs before the banker of the very highest eminence, nor of the Bank of England, Mr. s Gibbs. We had a long correhich Mr. Gibbs first printed at the land, and then allowed me to publish dix to my last book, "Chapters on litical Economy." The result was agreement on the great point at issue. will allow me to repeat to you a the question, as stated in "Fraser's of May, 1880. I could not state it or more fully:—

rs find it hard to exercise such a cool and judgment on the operations of their hen they are men. They encounter keen hey can be carried away by the impulses the prospects look bright: the rise of stimulating: and then calm reason is d. Nevertheless the banking community without the instinct of self-preservation, sought for a rule which should reveal the trade at the time, and enable them to iking with safety. But, unfortunately, upon a purely mechanical rule, a rule of te of common sense; but it lay so close so easy and so natural, and could be most ordinary brains. They bethought he reserve of gold, and a banking fact founded upon it so workable. London keep the substance of their reserves in ls. They have accounts at the Bank of which they store up their reserves, to never they please. Here is the grand ve of the nation, the supply of erve all banks from the danger of money and not having it. The salvation depended upon it. It must be carefully watched and nursed. If the reserve rises, let loans be freely made and upon lower charges; if the reserve diminishes, let every banker be on the alert. The Bank of England must then raise its rate of lending, and that rate must be the supreme law in every banking parlour. The reserve of the private Bank of England has thus become the king of all bankers. The doctrine has penetrated into every City article of every journal on every day throughout all England, and from England throughout the world. The law is treated as being as certain as the law of gravity. The movements of the gold are recorded as carefully every day for ascertaining the banking weather as the movements of the barometer are published for announcing whether rain or sunshine is approaching. One money market was established for the whole country—the money market of the Bank of England—the other bankers only followed suit. They lent and fixed their interest as the Bank of England directed."

Thus this unhappy absurdity overspread the nation. Its simple rule could be carried out daily with clever comments by every writer of City articles. The common mind could note its mechanics. Then it was very profitable for bankers. The bank rate brought an imperative excuse for levying a tax on all traders, and for an increase of the rate of discount as the reserve fell. It could always be pleaded that they were making the bank safe. It seemed to be an undeniable truth, that every bank which could not pay gold when demanded must become bankrupt.

In answer to this last plea, let us ask categorically, "When does this danger present itself?" Not when business is sound, and no mercantile failures are thought of, even though large sums of gold may have left the reserve. But when the panic has set in, and no one knows what bank may be broken during the day, or what great firm stopped before evening, then is the hour when the strong reserve is most sorely needed, and ought to be most resolutely provided. But what did the Directors of the Bank of England think of their own principle—the avowed governor of their practice—in the greatest of crises, in May, 1866? Did they hug every bag of sovereigns paid in to them, and lock it up in their reserve? They did the very contrary; they lent it out again as fast as they could; and thus, by their own voluntary action—aye, and with the applause of the Bagehots, and the great oracles of currency—they increased their loans from 18½ millions in April to 33½ millions in May, and emptied their reserve from 6½ millions to ¾—to less than 1 million; ¾ millions of gold, with 33 millions of loans voluntarily given. They then showed, with the greatest plainness, that they had no belief in the necessity of keeping up a great gold reserve, even in the hour of danger. They treated it with contempt by wilfully lending away in the day of peril for mercantile firms almost every sovereign they could lay their hands upon. They knew perfectly well, in the very teeth of the doctrine preached by themselves, the whole City, and every economical journal—that the public, as in 1825, would have been perfectly satisfied with payments in their own bank-notes, under the liberty of issue given by suspension. There was no fear anywhere of the goodness of these notes. With what feelings must any thinking man, any man of common understanding, read those pitiful daily announcements, with their corresponding comments, of a few hundreds of thousands, or even millions,

leaving the cellars of the Bank of England, as if they were anything more than ordinary variations of trade?

The natural action of money is never thought of by the holders of such ideas. Large quantities of money frequently leave the Bank amid profound tranquillity of trade. For what reason? Sometimes because the nation requires more money for currency, as in summer, with its harvestings and travellings, or oftener to pay for an excess of goods imported, or investments made abroad. But what harm is there in all this? Why should it be markedly chronicled as a grave fact, that five millions of gold have been sent to America to pay for sudden purchases of corn required for food? "No harm!" answers Mr. Hucks Gibbs. Money is made for the very purpose of passing from hand to hand, according to the purchases of the day. These five millions are sure to leave America again; they can do her no good in any other way. Her currency was full for the work required before they arrived. Is every trader in England to be warned by every city article, that out of a reserve which amounts to some 45 per cent. of the total liabilities of the bank, a few millions have departed to make purchases abroad? Is there danger, is there bankruptcy, in buying useful goods with gold locked up in vaults? It is lamentable to hear the language used about such events in banking and newspaper regions. Is it not the function of all currency to run? What if by such events the bank's reserve is to fall down to four millions of gold? Is every merchant to tremble in his counting house, every dealer in every exchange? Was anyone frightened about the bank's stopping in 1866, when it had not one million of sovereigns in its possession?

In conclusion, may I venture to say a few more words to you on a subject of extreme importance —the Monetary Conference, which is now sitting at Paris, to promote the universal acceptance of bi-metallism. I will not say, with the eminent economist, M. Leroy-Beaulieu, that this conference is "a gigantic hoax;" but I do not hesitate to declare in the plainest language that this meeting has for its distinct object the making of bad money—false and unreal money—for the whole world. Even one of the advocates of this new system, President Barnard, of Columbia College, has excellently stated that "the real money of the world is bullion;" as has been shown above, the sovereign does its work as the tool of exchange by its worth as a piece of metal—by its value as created by its cost of production.

Now, what is bi-metallism? It is most necessary to have a very clear and definite conception of the meaning of the word, if we are to judge correctly the kind of money it denotes. It is not the mere using by a country of two metals as the tools of its buying and selling. England employs gold and silver coins; but she knows nothing of bi-metallism, and it is to be hoped that she never will. England's money is gold. Her shillings are merely tokens, counters. The definition of a shilling is the twentieth part of a sovereign; the definition of a sovereign is so much weight of gold. The man who buys a ton of coals with a sovereign gives value for value; he who buys a cotton handkerchief with a shilling does not give as much silver as the handkerchief is worth. He gets the handkerchief because with 20 shillings the seller can get a sovereign, and thus he is real with gold. The shilling counters act like they mean and are twentieths of a sov They work no harm, because they cam more than 40 shillings worth of debt, an are not more of them allowed to be in cir than are sufficient to do the work of small

Bi-metallism is a wholly different aff essence is this—that a debtor must accept ment either of the two metals, in the fixed tious which the law assigns to them towa other. England would be bi-metallic i were passed authorising any debt to be shillings, and any quantity of silver to b into shillings. But what would be the even as matters now stand? Everyone w what he had nominally bought with so with shillings worth less than 20 to the pou could pay with 20, and probably have pro with his sovereign. He pockets four shi the expense of his creditor. The ultim would be, that silver would be bought ab gold to be coined into shillings, which w every debtor four shillings profit on a debt paid. Sovereigns would then leave and goods would be priced in shillings addition of more shillings to the price. T ment of debts with foreign countries most embarrassing, and accompanied by to many; but time fails to enter upon th

But the mischief is far from ending he when a nation, as England, has only g money, the uncertainty and greatness o loss even now occasion people anxiety payment of debts. We all know the uneasiness created by the presumed d the value of gold. Prices were held to for all articles, and those whose income on dividends, whether of Consols or otl thought themselves painfully poorer. danger bad enough with one metal for t exchange; it would be increased manif employment of two metals, available at to the debtor for the payment of his d bi-metallic shilling might be rated as sovereign; but how, if silver is extra cheaply from the mines, and the miner willing to give 30 shillings for a sovereig of gold? And these variations migh rapid, and enormous losses might be i creditors, in what they received as their in England and abroad. The misery c in the cost of gold alone would be bad en the changing worths of two metal authorised to pay debts in fixed propor can describe the sufferings they migl Would not the adoption of two standar are called, by the choice of either of t by debtors, be indeed a creation of d anxiety?

The bi-metallists are aware of this d of the ruin it would bring on the money— of any country; but they believe that discovered a remedy for the evil. Th value of the metals at present may be a 1 oz. of gold being equal to 18 ounces these quantities transferred in exchan yield equal worth of metal to each exch might have been expected that the bi would have taken their start from th

ty of 1 to 18; but no; from motives apparently are easily intelligible to some of their r, they assume the proportion of 1 to 15½, iving an excessive, unnatural, unreal, and artificial value to silver. They then pro-at the nations shall decree that gold and coins in that proportion shall be issued, and payable for all debts. If the creditor was the option, he would reject the deficient contained in 15½ of silver for his debt in They do not deny that he would be d, but they think they have found the in limiting the coinage of silver so as to it pass for what they please, and thus g the gold and silver coins to be exchanged eir own selected proportion of value. If oly of all the silver mines could be created, it be possible to create such a system. ight be made scarce in comparison with and for it, and thus its value might be ed at the required proportion of 15½. But monopoly is a pure delusion. In any con-case, many silver-producing nations would out, and they would ruin the projected . They would make silver coins for all the ry Union States, forged, but all of full silver introduce them easily into the monetary s, deluge them with these coins, with im-profit to themselves. Thus silver would the sole coinage of these countries, and ld would disappear. The law of all money hen assert itself—prices would all rise—al would form that money, and debtors, s, and traders of every kind would be de-ver to the extreme uncertainties of the f silver. The relation of debtor and would become intolerable; and gold ltimately be restored to its supremacy as

while, another result would be sure to All goods would have two prices—one in e other in silver; and this last would vary the fluctuations of the worth of the metal. ossible motive can be assigned for subject-nations to the folly of selecting such

on the other side, it must be admitted that st important to retain the use of silver for ns of the world. To banish silver alto-even were it possible, would lead to a great ment of the worth of gold, to a scarcity n comparison with the work which it would do, and many inconveniences would arise. s only one principle, as far as I know, on the joint bi-metallic use of silver, in com-n with gold, can be carried out successfully, ggested by Mr. Clarmont Daniell, in his let, "Gold in the East," and further de-d in the *Westminster Review* of January, He proposes that gold should always be ndard, and remain unchanged; but that should also be a complete legal coin for all but in such proportion to gold as shall be ined from time to time by a public autho-ording as its intrinsic value, its metallic shall suffer fluctuations. In this manner editor will always receive in silver the gold of his debt, and silver, under such conditions, employed without mischief to perform the ask of currency.

DISCUSSION.

The Chairman said they had had a most interesting and instructive paper on a subject which the Society had not discussed much recently, and he thought they would all agree that the Professor deserved their sincere thanks. For his own part, nothing would please him better than to be able to sit under Professor Price in the theatre at Oxford, and learn more thoroughly the principles which he had enunciated. The author had very fully treated of the value of money as a tool for the purpose of exchange, and in the main principles enunciated he entirely agreed with him. Money, after all, was simply a convenient method by which to regulate exchanges. It had a recognised value by which we could regulate exchanges and balance accounts. Trade was simply a system of barter regulated by the exchange of money in order to effect the balance at the end of the year. If that was the case, they arrived at the principles so ably stated in the paper. There were, however, one or two points on which he was not prepared to go entirely with the author. The case of a hat and a sovereign had been mentioned, but he must say he thought a sovereign had an intrinsic value greater than a hat, though the cost of producing it might perhaps be rather less of the two. There was a great deal of labour involved in the various processes of manufacture of the hat, whilst the gold was found in the ground, though of course, it required a certain amount of labour to extract it. It appeared to him there was as much labour required to find a diamond, which was worth several times as much as the gold. Then, again, gold had a certain difference in value. Some years ago he visited Australia, and bought some gold there, which he sold in London at £4 2s. 6d. per ounce, though the standard value, as regulated by the Act of 1844, was £3 17s. 10½d. He got this enhanced price in consequence of what was called the betterness of the gold, and that gold naturally would be valued higher than standard gold; yet it was as easy to produce as gold of lower value. It therefore appeared to him that gold had a value over and above that created by the simple production. This, however, was a point which might be open to question; and he was not prepared to discuss it fully. With regard to bi-metallism, it appeared to him that if, by any means, they could prevail upon the Government of India to introduce a gold standard, instead of a silver one, the effect would be to very much improve the trading relations of this country. It would lead to a considerable absorption of gold in India, and cause the purchasing power of gold to rise here. Silver would be simply used for a token coinage, and for useful manufactures.

Prof. Price said, with regard to the observations of the Chairman, that it was quite true that the finances of India had been very disastrously affected by the fall in the value of silver, because a large proportion of the income of India was fixed, a hundred years ago, at so many hundred silver rupees; and instead of being worth 2s., they were now only worth 1s. 6d. Therefore the Government had to buy at much dearer rates, while its income, which could not be altered, was worth very much less. He knew only one principle on which the object aimed at could be attained, and it was the one referred to at the close of the paper, recommended by Mr. C. Daniell. Gold had a greater intrinsic value than copper, simply because a much greater amount of the latter was produced with a given quantity of labour.

Mr. Pfoundes remarked that in ancient times, not only had skins a fictitious value, but a fluctuating value, according to size and quality, and, therefore, certain ancient American and Eastern tribes adopted the plan of cutting a piece out of the skin, which became a token. That he believed was the earliest known instance of a

token being used in lieu of the thing itself. Again, letters of credit and bills of exchange were by no means modern; they existed in China and the far East in very ancient times; the necessity for not keeping large amounts of capital locked up was recognised nearly twenty centuries ago. He had seen some very ancient bills of exchange in the East, which had passed from hand to hand as money. There was also in ancient times another standard of value, viz., a measure of rice, the standard measure being an average days' ration for an adult. Of course this somewhat fluctuated as there was a scarcity or plenty, but in times of plenty it was stored up against times of scarcity. Besides this, there was an arbitrary standard, which was supposed to represent the value of rice in metal, and it was said that so many days' rations of rice equalled a certain standard of gold, which was the metal *par excellence*. Within his own experience, the Carolus dollar in China was worth from 60 to 70 per cent. more than its actual value in silver during a certain period, and other well-known coins had a value far above their intrinsic value as metal. He might also mention that a paper currency had been issued on the basis of the rice standard, and he once had a large number of specimens, which were now in the possession of the Emperor of Austria, of this old paper currency; the different notes or tickets representing one day's ration, one and a-half days', five, or ten days' rations of rice, and these passed from hand to hand. It was a curious fact, that when the English established a mint in Hong Kong, they were obliged to close it, most of the *employés* being sent to Japan, because the Chinese would not adopt the currency, and he believed most of the gold and silver coins went to adorn the jackets of young swells in Canton.

Mr. Robert Manuel said Mr. Price had described the object of the Conference now sitting in Paris as an attempt to foist silver money on the world at a fictitious value. He must admit that, when its actual value was in the ratio of 18 to 1 of gold, and they were trying to get it into circulation at 15½ to 1, that course could not be justified; but was not the ratio of 15½ to 1 a fair one, taking the old value of the silver? And they had to consider why silver had fallen in value. Was it not, to a great extent, due to the action of the German Government, who, some ten years ago, finding themselves rather flush, thought they would demonetise their silver and adopt a gold standard. They were, perhaps, wise in doing so, but the result was to flood the market with silver, and it was well known to those who dealt in bullion that the German Government had now in their coffers silver which they they were waiting to sell when opportunity offered, and this was always a bugbear in the silver market, and kept down the price. He would not urge that our Government should adopt bi-metallism, because we got on very well with gold; but it must be borne in mind that, if the suggestion of a gold currency in India were adopted, it would make such an enormous demand on the stock of gold—which was not by any means too large for the requirements of western civilisation—that it would appreciate to a serious extent the value of the metal. Again, the habits of the people of India were different to those of the west; there was a tendency amongst Hindoos to hoard, and if they had a gold currency, they would hoard gold as they did silver; and being smaller in bulk, the effect would perhaps be worse. He would ask whether it would not be better for the world in general if those nations which were willing to act on the bi-metallic principle fixed on some ratio—if 15½ was not fair, say 16 or 16½ to 1, or something approaching the actual ratio, and by that means re-introduce silver into the currency, which would then force up silver to something like its old value. We should have our one gold standard, and in India there would be a silver standard, but the Government would save the loss on the exch now amounted to about three millions a ye

Mr. Wm. Botly said the last speaker h principles on which he should have address ing, and he would merely add that, havin Colonel Smith's paper on bi-metallism, he w clined to the opinion that if silver were ma gold, it might be a great advantage to this the legal tender of silver were raised from would be a great convenience, and would prejudice which was now felt against it. to India, he feared it would be almost adopt a gold standard with advantage; b might be made of varying weight. It w possible, in a country like India, to do bet silver in value.

Mr. Hedley Millyard said the Profess gold purchased by reason of its cost of pr if that were so, gold must be taken as commodity in exactly the same way as a you might substitute for gold in that bale of cotton piece goods. Then it amo that a bale of cotton bought by virtue production; but it had been proved as *pons asinorum*, that its sale was simply re demand for it. The question of the pur of gold cropped up again when the gr discussed whether gold had of late years l or dearer. It would seem that the only da determining the purchasing power of primeval distribution, which it was im with other than deductively. They h which they could treat the question in whether gold had been dearer or was Whether the gold discoveries of late ye to neutralise any deficiency which come about in the currencies of the w quence of wear and tear, was a question to determine deductively. The Profess at the alarm which was felt in merca the question of whether our imports ex ports, but he did not think the question settled in that way. Some years ago instance when the Bank of Englan saved by borrowing two millions of Bank of France, and that clearly sho were some specific phenomena by wh gauge this question. It showed tha bullion might go on unperceived, and known in the event of a commercial c case clearly we were not aware of the Bank of England, and it was very proble the proposition were true if we took mercantile statistics. Take the carpet position of that trade with America. said that the fact that our imports excee was beneficial to this country, inasmu tective purposes, our goods were pract from America altogether.

Mr. M. S. S. Dipnall thought the imperi had been rather overlooked in considerin you took hats, umbrellas, or shoes, and lo a closet for a hundred years, they woul worthless, probably they would be no whereas a sovereign would be as good a coined. The subject of bi-metallism wa he had much studied, but it struck him t sovereigns with shillings, there would more wear and tear in the latter represe value, and therefore there must be some di the value of the two metals for purposes o that point of view alone. With regard could be no doubt that many men there h the depreciation in silver, owing to the their contracts were made in that metal; they all deplored, but he did not see h

Vith regard to the Chairman's remarks ian gold being worth £4 2s. 6d. an ounce, ccount of its greater purity; the standard th £3 17s. 10½d., and if gold were found ity, clearly the owner was entitled to the Ie did not readily see how two distinct ld exist in any fixed ratio to each other, of time together.

a remarked that Professor Price seemed by having a gold standard they were not inconvenience of fluctuation in the value suppose the commercial value of gold changed by some discovery which should production on the one hand, or, on the nake it more valuable, the value of debts old would then change accordingly. If eat, or cotton, or anything else as the would be always exposed to the same ld happened to be a little more staple, e believed the use of it as a standard conuations, and that there was little more n that in it. It was said that silver coins ms, but he thought it would be almost n for a powerful Government, to substier metal. The silver shilling might not isely the value it was supposed to repreroached very closely to such representation. o the question of exports and imports, he hat from the Professor, when he said we e alarmed because our imports were in it showed we were getting richer. The what was meant by getting richer? we were now receiving the interest hich was invested in New Zealand, other places. But what was the process capital was invested there? Was it not s greatly exceeding the imports for a me? We sent out steam-engines and a ther things, as investments, from which eceiving the interest, and that was the ich we got rich. But now, when we more imports, the question was what ts they were, whether we were getting r, and whether or not we were spending ich was invested abroad. Suppose that this d very large sums in American securities nerican war; most of it was sent out in nerchandise; and were they not, at that richer? Then, during the time of bad received a very large proportion of our merica, and consumed it, it seemed to e end we might have eaten up, in the shape t we had invested in former times, when it to America; and that seemed to him a ing poorer, and not richer. At any rate, fence of those who thought that an excess not a healthy state of things.

an having proposed a vote of thanks to e, which was carried unanimously,

rice, in reply, said he quite agreed ntlemen who desired that both silver ould be used. The supply of gold for all the purposes of currency, and id of silver it would acquire an artificial value. All he meant to say was that he of any other way in which the two metals ed together than that of one being taken as and that the other be adapted to it, in ts cost of production. Mr. Daniell's idea y small stock of gold should be used in a large quantity of silver should be used hat the payment of debts in silver should be ding to the proportion which silver bore to gard to token coinage, in Austria and elsere shilling and even fourpenny notes, and perfectly well, except that they got dirty and torn, and were hard to distinguish. A hard token like silver had a great advantage from its durability. He could not answer Mr. Hillyard's questions without going into the whole subject of banking, which was too large a one to enter upon then. One of the reasons why a large supply of coin was not wanted in England was that our machinery of payment by means of cheques, and the Clearing-house system, was so perfect; but all this was arranged on the basis of a gold standard. With regard to exports and imports, of course they might have various motives, but those who made investments abroad were not the people who talked about exports and imports, it was always the traders, and as a matter of trade, the advantage was in the imports. Debts might be paid this year or next, or in ten years time, but the exchange was always of goods. If England made foreign loans, it was always in goods; she had no superabundance of gold to send abroad. If she had spare goods, it might be a good investment to send that extra store got by saving and productive consumption abroad as exports, with the intention of the equivalent not coming back, but that was not the language of the mercantile world to which he was alluding. Imports might be like American wheat, which supplies the place of a great destruction of wealth here. There was no doubt we had had very defective harvests, and the alternative was either to buy corn abroad or starve. Of course he did not mean to say that the buying American corn under such circumstances was a sign of prosperity, but it was an excellent purchase nevertheless, and the importation was a source of wealth, because it kept the nation alive. The loss was not in the importation, but with the loss of the harvest. But that was not the question with which he was dealing. The principle always remained the same; trade was an exchange of goods and nothing else whatever.

GENERAL NOTES.

The Commerce of London.—Sir John Lubbock has communicated to the papers the following account of the operations of the London Bankers' Clearing-house for the year ended April 30:—

"15, Lombard-street, May 2.

"Sir,—I beg to forward you the subjoined statistics, showing the working of the Bankers' Clearing-house for the year ended on the 30th of April, 1881, which is the 14th during which these statistics have been collected. The total amounts for the 14 years have been—

	Total for the Year.	On Fourths of the Month.	On Stock Exchange Account Days.	On Consols Settling Days.
	£	£	£	£
1867-1868	3,257,411,000	147,113,000	444,443,000	132,293,000
1868-1869	3,534,039,000	161,861,000	550,622,000	142,270,000
1869-1870	3,720,623,000	168,523,000	594,763,000	148,822,000
1870-1871	4,018,464,000	186,517,000	635,946,000	169,141,000
1871-1872 ...	5,359,722,000	229,629,000	942,446,000	233,843,000
1872-1873	6,003,335,000	265,965,000	1,032,474,000	248,561,000
1873-1874	5,993,586,000	272,841,000	970,945,000	260,072,000
1874-1875	6,013,299,000	255,950,000	1,076,585,000	260,338,000
1875-1876	5,407,243,000	240,807,000	962,595,000	242,245,000
1876-1877	4,873,000,000	231,630,000	718,793,000	223,756,000
1877-1878	5,066,533,000	224,190,000	745,665,000	233,385,000
1878-1879	4,885,091,000	212,241,000	811,072,000	221,264,000
1879-1880	5,265,976,000	318,477,000	965,533,000	233,143,000
1880-1881	5,909,989,000	240,822,000	1,205,197,000	265,579,000

The total amount of bills, cheques, &c., paid at the Clearing-house during the year ended April 30, 1881, shows an increase of £644,013,000 as contrasted with 1880. The payments on Stock Exchange account days form a sum of £1,205 197,000, being an increase of £239,664,000 as compared with 1880. The payments on Consols account days for the same period have amounted to £265,579,000, giving

an increase of £32,436,000, as against 1880. The amounts passing through on the 4ths of the month, for 1881, have amounted to £240,822,000, showing an increase of £22,345,000, as compared with 1880. At the same time I may observe that four Consols settling days fell on 4ths of the month, while there only happened one last year. This would account for a considerable portion of the increase. Messrs. Derbyshire and Pocock, the inspectors of the Clearing-house, have been good enough to prepare for me the above figures, which will, I think, be interesting to many of your readers.—I am, sir, your obedient servant,

"John Lubbock, Hon. Sec. London Bankers."

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at eight o'clock:—

May 11.—"The Manufacture of Glass for Decorative Purposes." By H. J. Powell (Whitefriars Glass Works).

May 18.—"The Electrical Railway, and the Transmission of Power by Electricity." By Alexander Siemens. Dr. Siemens, F.R.S., will preside.

Foreign and Colonial Section.

Tuesday evenings, at eight o'clock:—

May 10.—"Trade Relations between Great Britain and her Dependencies." By William Westgarth. Lieut.-Colonel Sir Robert R. Torrens, K.C.M.G., will preside.

Applied Chemistry and Physics Section.

Thursday evenings, at eight o'clock:—

May 12.—"Recent Progress in the Manufacture and Applications of Steel." By Prof. A. K. Huntington.

May 26.—"Telegraphic Photography." By Shelford Bidwell. Prof. W. G. Adams, F.R.S., will preside.

Indian Section.

Friday evenings, at eight o'clock:—

May 13.—"Burmah." By General Sir Arthur Phayre, G.C.M.G., K.C.S.I., C.B. Sir Rutherford Alcock, K.C.B., will preside.

Members are requested to notice that it may be necessary to make alterations in the dates of the above papers.

Cantor Lectures.

Monday evenings, at eight o'clock:—

The Fourth Course will be on "The Art of Lace-making," by Alan S. Cole. Four Lectures.

Syllabus of the Course.

Lecture IV.—May 9.

Resumé as to styles of design in hand-made lace. Traditional patterns. Sketch of the development of inventions for knitting and weaving threads to imitate lace. Differences between machine and hand-made laces. Modern hand-made laces at Burano, Bruges, Honiton, &c.

This course will be illustrated by specimens of lace. Diagrams and photographs enlarged will be shown by means of the lantern and oxyhydrogen light.

MEETINGS FOR THE ENSUING WEEK.

Monday, May 9th...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. Alan S. Cole, "The Art of Lace-making." (Lecture IV.)

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. Mr. Edward Whymper, "A Journey amongst the Great Andes of the Equator."

British Architects, 9, Conduit-street, W., 8 General Meeting.

Tuesday, May 10th...SOCIETY OF ARTS, Adelphi, W.C., 8 p.m. (Foreign and Col Mr. William Westgarth, "Trade Rel Great Britain and her Dependencies."

Royal Institution, Albemarle-street, W. Dewar, "The Non-Metallic Elements."

Medical and Chirurgical, 53, Berners-s street, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. John I. Thornycr Boats and Light Yachts for High-Speed tion."

Photographic, 5A, Pall-mall East, S.W., 8

Anthropological Institute, 4, St. Martin' 8 p.m. 1. Prof. G. Dancer Thane, "Some 2. Lieut.-Col. R. G. Woodthorpe, "The the Naga Hills."

Royal Colonial, Grosvenor Gallery Libr Bond-street, W., 8 p.m. Sir Charles N Principle which ought to regulate the d the Political and Municipal Boundaries of the Colonies."

Royal Horticultural, South Kensington, 8

Wednesday, May 11th...SOCIETY OF ART Adelphi, W.C., 8 p.m. Mr. H. J. Powel facture of Glass for Decorative Purpose

Geological, Burlington-house, W., 8 p.m. W. Davis, "Notes on the Fish-remair bed at Aust, near Bristol, with the Des new Genera and Species." 2. Rev. "Certain Quartzite and Sandstone Fossi in the Drift in Warwickshire, and identity with the true Lower-Siluria similar Fossils, in the Trias at Bud Devonshire." 3. Mr. Francis D. Long mens of *Diastopora* and *Stomatopora*, fr Limestone." 4. Prof. W. J. Sollas, " of *Plesiosaurus* (*P. Conybeari*) from the Charmouth."

Microscopical, King's College, W.C., 8 p.

Royal Literary Fund, 10, John-street, 3 p.m.

Ascham, 18, Baker-street, W. Prof. "The Place of English in a Liberal Ed

Thursday, May 12th ... SOCIETY OF ART Adelphi, W.C., 8 p.m. (Applied Chem Section.) Professor A. K. Huntingto gress in the Manufacture and Applicat

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p

Society for the Encouragement of Fine street, W., 8 p.m. Dr. Phené, "Art I

Royal Institution, Albermarle-street, W Tyndall, "Paramagnetism and Diamag ture III.)

Inventors' Institute, 4, St. Martin's-plac

Royal Society Club, Willis's-rooms, St. 6 p.m.

Mathematical, 22, Albemarle-street, W., W. R. W. Roberts, "Note on the C Tangent Line to the Curve of Inte Quadrics." 2. Mr. E. Carpmael, "So the 15 School-girl Problem." 3. Mr. C "Note on Ptolemy's Theorem." 4. "Algebraical Notes." 5. Rev. T. I Summation of Certain Hypergeometric

Friday, May 13th...SOCIETY OF ARTS, John W.C., 8 p.m. (Indian Section.) Gen Phayre, "Burmah."

Royal United Service Institution, Whitel Captain J. R. Colomb, "Naval Intell Protection of Commerce in War."

Royal Institution, Albemarle-street, W., Meeting. 9 p.m. Mr. F. Galton, "Me Vision."

Astronomical, Burlington-house, W., 8 p.

Folk-Lore, 22, Albemarle-street, W., 8 Wheatley, "The Superstitions of Pepys

Clinical, 53, Berners-street, W., 8½ p.m.

New Shakspeare, University College, W.C J. Kirkman, "The Suicides in Shak 2. Mr. F. J. Furnivall, "The Cruxes early Comedies."

National Health Society, 23, Hertford-st (Drawing-room Lectures.) Mr. H. Po Education of the Eye."

Saturday, May 14th...Physical, Science Schools, ton, S.W., 3 p.m. Prof. H. A. Rowland Nichols, "Electric Absorption in Cryst

Royal Botanic, Inner-circle, Regent's-park

Geologists' Association, University Colleg sion to Croydon.

Royal Institution, Albemarle-street, W. Henry Morley, "Scotland's Part in Engl (Lecture III.)

OF THE SOCIETY OF ARTS.

No. 1,486. VOL. XXIX.

RIDAY, MAY 13, 1881.

...for the Society should be addressed to the Secretary
...John-street, Adelphi, London, W.C.

NOTICES.

CONVERSAZIONE.

y's *Conversazione* is fixed to take place Kensington Museum (by permission s of the Committee of Council on on Thursday, June 2nd. The cards of ill be issued shortly.

CANTOR LECTURES.

1 and concluding lecture of the fourth "The Art of Lace-making," was ALAN S. COLE, on Monday, 9th inst. gave a *resumé* of his subject, and the variety of styles of design in hand- He then described the development of or knitting and weaving threads to and showed the distinctive differences chine and hand-made lace, by means ed photographs shown on the screen. d with a notice of the modern hand- f Burano, Bruges, Honiton, &c. specimens of lace, kindly lent by Mrs. ison, Messrs. Hayward, and Messrs. James, were exhibited on the table. thanks to Mr. Cole, for his interesting ctures, was proposed, and carried .

FURNITURE EXHIBITION.

ations for the Exhibition of Works of o Furniture at the Royal Albert Hall rly completed. The Exhibition will n Monday, May 16th, at the same General Art Exhibition at the Albert

PLANT LABELS.

In response to the offer of a medal and prize of £5, for the best labels for plants, labels have been received from 120 competitors.

PRACTICAL EXAMINATION IN VOCAL OR INSTRUMENTAL MUSIC.

The next Examination in London will be held by Dr. Hullah, the Society's Examiner, at the House of the Society of Arts, 18, John-street, Adelphi, W.C., during the week commencing on the 4th July, 1881.

HONOURS.

The Examination in Honours will consist of three sections, viz., a paper to be worked, an examination similar in form to the practical examination for a First and Second-class, and a *viva-voce* examination.

FIRST AND SECOND-CLASS.

Vocal.

Candidates for a First or Second-class Certificate in Vocal Music will be required—

[1.] To sing a solo, or to take part with another candidate in a duet, already studied.

[2.] A key-note being sounded and named by the Examiner, the candidate to name sounds or intervals, or successions of sounds or intervals, played or sung by the Examiner.

[3.] To sing or sol-fa at sight passages selected generally from classical music.

Instrumental.

Candidates for a First or Second-class Certificate in Instrumental Music will be required—

[1.] To play a short piece, or a portion of a larger work, already studied.

[2.] A key-note being sounded and named by the Examiner, the candidate to name sounds or intervals, played by the Examiner.

[3.] To play a piece or portion of a piece at sight.

The fee is 10s. for the Honours (including both vocal and instrumental Examination), and 5s. for the First or Second-class (vocal or instrumental) Examination. If vocal as well as instrumental music, or two separate instruments, be taken by the same candidate for the First or Second-class Certificate, a fee of 7s. 6d. must be paid.

The examination of each candidate will be private; no one but the Examiner and the accompanyist being present, unless it be a member of of the Society of Arts' Committee.

No list of Candidates will be published.

Full particulars can be obtained on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

FOREIGN AND COLONIAL SECTION.

Tuesday, May 10th, 1881; JAMES A. YOUL, C.M.G., in the chair.

The paper read was—

TRADE RELATIONS OF THE COLONIES AND THE MOTHER COUNTRY.

By William Westgarth.

INTRODUCTORY REMARKS.

In presenting adequately to my audience the great subject I have ventured to take in hand, it will be necessary to begin with a few introductory and explanatory remarks upon the colonial or external parts of our Empire. The importance of that part of the British Dominions cannot be better illustrated than by the fact that it comprises forty distinct societies and governments, whose united public yearly revenues are over 90 millions sterling, with a total yearly trade of 320 millions; that it covers an area of nearly nine millions of square miles, or about one-seventh of the whole land surface of our globe, with a population of 254 millions, or no less than between one-fifth and one-sixth of that of the whole world.

But first let me make here a passing comparison with the illustrious mother of the family, who, indeed, cannot fail to be illustrious, even if she were nothing more than the mother of so great and varied a household. But she has, besides, her own attainments to stand upon. Within an area only 1-75th of that of her family, and a population of between a seventh and an eighth, she now creates, within that comparatively small space of about 120,000 square miles, a yearly public revenue of more than eighty-four millions; and with 633 millions of yearly trading, has nearly twice the amount of the united total trading of all her vast family.

This colonial family is most variously—indeed, picturesquely—constituted, embracing, as it does, very large proportions of other races than our own, a great variety of climate and production, and no small diversity in social and political aspects. I distinguish three leading classes of our outside possessions:—1st, Colonies proper, consisting substantially of societies of our own race. These are, respectively, the North American group, now all, with only the one exception of Newfoundland, comprised in the Canadian Dominion; the Australasian group, and the Cape Colony. All these enjoy a reflex of our own system of constitutional self-government, subject, of course, to imperial supremacy. 2nd, Dependencies of substantially foreign races, which, as the rule, are not constitutionally governed, that is to say, by popular representation, but by a system of Crown nomination, and, therefore, distinguished as Crown Colonies. Of these, our great leading figure is India; and we have, besides, Ceylon, the Straits Settlements, Mauritius, Natal, the West Indies generally, Guiana, Honduras, Sierra Leon[e] Coast, and some others. 3rd, Military C[olonies] as Gibraltar, Malta, Cyprus, Bermuda, As[cension] St. Helena, &c. I might have found yet [a] class in convict colonies, such as Bermu[da] continues; but as that is now an expiring [system] I have included its remnants in the milita[ry]. Within only the last forty years, howe[ver, the] convict system has included, besides B[ermuda], New South Wales (with its offshoot, [Norfolk] Island), Tasmania, and West Australia.

No clear line, however, separates the[se] classes from each other. There is parti[al repre]sentative privilege in some of the Crown [Colonies]. It might be puzzling in which class pr[operly to] put little St. Helena, although I have giv[en it to] the military. Then, again, there are gre[at and at] times disturbing foreign social elements [in the] free or constitutional colonies. The [Indian] native element in Canada is of no politic[al weight], but there is a large although happily [loyal] French element. In Australia again, t[he abori]gines have never raised a political qu[estion, but] the case has been very different in New [Zealand]; and lastly, in our Cape dominions we hav[e had, and] still have, most embarrassing relations [with both] the Dutch and the aboriginal elements.

MODE OF TREATING THE SUBJE[CT].

Our view of the trade relations of c[olonies] to the mother country would be quite [incomplete] if we omitted allusions to these politi[cal circum]stances, connected as they are too [with that] important but interminable tariff ques[tion which] springs up everywhere over the colon[ial empire], and which claims our attention equal[ly with the] trading which it affects or regulates. [I propose,] therefore, to present my subject in th[e following] order:—

First, we shall look at the progress [and] attainments of the trading between t[he mother] country and the colonies, with a compar[ative glance] at the foreign trading.

Second, we shall examine some of [the leading] features and chief items of all that trad[ing].

Third, we shall consider the trade r[elations with] regard, mainly, to the relations, compl[ications, and] difficulties of the tariff question.

Fourth, and lastly, we shall make so[me general] reflections on the whole case.

I am aware that this Society exclud[es political] controversy from its proceedings; and [very pro]perly so, seeing that the great political [parties of] the country may equally meet within t[hese] walls, to promote its many national [and useful] objects. But the large and varied col[onial ques]tion, when we have occasion to touc[h on this] part of it, is happily, as you will [see, not a] political one, in the objectionable sen[se of] political parties.

I have yet one further introducto[ry remark]. My subject bristles with facts and fig[ures, and it is a] too common fault of papers of this kin[d to over]load and weary the memory in that w[ay. I have] carefully tried, and I hope successfull[y, to avoid] that fault, while at the same time not [omitting] such sufficiency of statistical illustratio[n as may do] full justice to my subject, and ma[ke it] intelligible to my audience.

OGRESS AND PRESENT POSITION OF THE
DING BETWEEN THE MOTHER COUNTRY AND
COLONIES, AND COMPARISON WITH FOREIGN
DING.

Two Remarkable Features.

glancing over the figures presented by our
rce, we are at once struck by two different
markable features; one, the largeness of the
nt as compared with that of other countries,
he other the comparative velocity of the pace
ease or progress in these later years. In the
nt of our total trade, that is to say, of our
ed imports and exports, our country is far
d any other country in the world, not
ng even such advanced commercial countries
ce and the United States, although their
ghly organised, industrious, and highly
ent populations respectively exceed our
While our total trade for 1880, exclusive of
nd bullion, reached 633 millions, that of
for the same year was £332 millions, and
the United States 317 millions. If to the
figures of our United Kingdom we add the
llions of the aggregate colonial trading, we
to nearly 1,000 millions for the whole
an amount that makes a very substantial
h to the total trading of all the rest of the
cial world put together.

other striking feature, that of the accelerated
s of the later years, is so interesting, more
ly as it appears to be common to the other
t nations of the day, that I shall hope to
sed if I dwell here for a moment upon it.
ook back only twenty years. Our country's
, now 633 millions, was then but 347
; that of France, now up to 332 millions,
n only 157 millions; and that of the United
now at 317 millions, was then but 143
. Although our country now stands com-
ly so far ahead of any other in the world,
n be no doubt that if, like Rip van Winkle
he Atlantic, we were to drop asleep for a
years, or perhaps even for but the one-
that short space of a nation's life, we
awake to find that France and the United
ad both overtaken or surpassed us. By so
step ahead in this inspiring race is our
supremacy held.

remarkable acceleration of commercial pace,
rds our own particular case, appears to
begun about half a century ago. The
tion has indeed been of a general as well
merely commercial nature, and has been
ble alike also to social, political, and
ic progress. Our great colonial develop-
lso are mainly within that brief space. In
anada had but small pretensions compared
present four millions of colonists, five
s sterling of yearly revenue, and fifty-five
s of yearly trade. The wide and expanding
ttlements, now so conspicuous for wool and
products in the empire's commerce, were
ndustrially considered at least, an almost
space, hardly more than geographically
r to us. Australia was known here as being
ore to us than the two convict settlements
South Wales and Van Diemen's Land (now
nia); whilst the newest member of the
New Zealand, contained, colonially speak-
ing, but a handful of adventurers and missionaries, the latter of whom in particular, as Sydney Smith, in his characteristic way, has humorously reminded us, served occasionally as choice delicacies on the sideboards of cannibal natives. But already, Australasia, with three millions of colonists, sixteen millions of yearly revenue, and ninety millions of yearly trading, is casting even Canadian progress into the shade.

In this remarkable feature of a greatly accelerative progress, the colonies generally are stepping ahead of, and in some cases—as in the instances given—even much more rapidly ahead proportionately than the mother country herself. We may have some reflections to offer on this portentous condition and prospect further on. It is portentous, but by no means unwelcome or alarming. But turning, meanwhile, once more to the home picture, we see the acceleration in question fairly illustrated by the progressive statistics of our shipping. The collective outward and inward tonnage for the United Kingdom, exclusive of the coasting trade, appears as follows, prior to and after 1830, or fifty years ago:—For 1814-16, the yearly average was 4·3 millions of tons; for 1820, 5·3; for 1830, 5·8. Thence, entering the era of marked acceleration, we have for 1840, 9·4; for 1850, 14·5; for 1860, 24·7; for 1870, 36·6; for 1878, 51·6. In the total trade also we show the same remarkable later acceleration; and we have that feature in common with France and the United States, whose cases have been just alluded to; for while our present amount is 633 millions, 25 years ago it was but 289 millions, or considerably less than the amount to which either France or the States have now attained.

The Uncertainty of Past Official Trade Records: "Official" and "Real" Values.

Allow me here a few words upon a very important, but not much understood, subject, namely, the uncertainty, or rather the totally misleading effect of the system of our earlier official trade records, and more especially as to the import trade prior to the year 1854. I have pleasure in acknowledging that I owe the information I am now giving you chiefly to my friend, Mr. Stephen Bourne, the able and practised statistician of our Customs' department. We are still lingeringly familiar with the alternative terms "official" and "real" values in our import and export figures; for until 1869, when the "official" were given up, both used to be presented to us. We may readily guess at the meaning of real, but what are "official" values? The old or original Custom-house practice was to keep the respective values unchanged, as they were handed down from past years, no matter what change in price had really occurred in the interval in the articles imported or exported. When a new article appeared in the list, its value at the time was recorded, but at that value or price it afterwards unchangeably stood. In this way we have complete returns dating from 1699, but returns utterly unreliable, except in a comparative way, not as to value, but as to quantity. Fortunately, a "real" value for the exports has come concurrently down to us with the "official" value from 1798. A real value was then first required for the purposes of a war tax in that belligerent time for convoys to merchant

ships, and this real value system as to exports was, happily, afterwards kept up. The difference between the two values gradually accumulated to a ludicrous extreme; for at the last record in 1869, while the real value of our exports was 237 millions, the official value had run up to 456 millions.

The imports, on the other hand, are simply and solely "official," up to 1854, at which time, while this official value was but 124 millions, the real value had attained to 152 millions, showing the first to be about 23 per cent. short. As Mr. Bourne remarks, the exports had been progressively cheapened by competitive production, and the imports advanced by greater demand and larger means of purchase. In 1854, there was added to the official value system that of a "computed" real value. It was only in 1872 that the imports as well as the exports were returned by "declared" real values. Considering how long it lingered in life, into these modern advanced and commonsense times, the official value record is one of the most curious in red tape annals. As one instance of uncertainty in the utter divergency from fact, we may quote the official value of the imported article wood in 1854 as being £1,812,690, while the real value turned out to be no less than £11,064,694. In another instance, that of the article tea, the real value is exceptionally a reduction instead of an increase, for it is £5,540,735, while the official value is £8,579,203. Thus, tea had become considerably cheaper since it was enrolled as an import in our Customs list, while wood had become very much dearer.

The colonial Customs returns, so far as I can learn, appear to have been always kept in that common sense correctness of real values to which we at home have at last happily attained. But as regards the home figures, while those of exports are reliable for above 80 years past, those of imports, on the other hand, cannot be trusted till as far on as 1854.

Our Colonial versus our Foreign Trade.

In viewing the great trade of our country, we are, of course, for the present more particularly interested in the proportion of it which is concerned with the colonies. Our free trade system, which is unquestionably the chief cause of our trading supremacy in the world, gives as yet much larger proportions to our foreign than to our colonial trading. Thus, while our total trade of 1879 is 612 millions, the colonial portion is 146 as against 466 foreign. Nor is there much difference in these proportions during the last quarter of a century—for in 1855 they are 62 and 198; in 1865, 124 and 366; and in 1875, 161 and 495. The returns, however, give a tone of cheerful progress. While, in 1855, the total of imports from colonies is 34 millions, in 1879 it is up to 79 millions, and in the same way the exports to colonies are respectively 28 and 67 millions.

But if the totals of the colonial figures are still so considerably below those of the foreign, we find an extremely different result when we take the amount of trading as per head of population. In this way Canada, at 32s. per head, takes from us four times more than the United States. And again, while our 15 millions of exports to France are but little different from about 16½ millions to Australasia, yet, in point of population, the true difference is as about 8s. to abo[...] head.

II.—CHIEF FEATURES AND PRINCIPAL [...] OF THE TRADE BETWEEN MOTHER [...] AND COLONIES.

Colonial Raw Materials and Home Ma[...]

As we should theoretically expect, so [...] find, that our colonies and dependenci[...] raw materials, and that, in return, [...] mother country, with our larger ca[...] better organised and more abundant la[...] back to the colonies these raw mate[...] manufactured state. This is remarkabl[...] with wool, an article at once of the h[...] portance and of enormously increasin[...] production at the Cape and Australia. [...] case also, although in less marked degre[...] West India and some other colonial n[...] It is still so to some extent, too, with c[...] India; although latterly, with our fu[...] resumed from America since the Civi[...] importations from India have greatly [...] We get now only about four million po[...] yearly of Indian cotton, whereas, in ou[...] caused by the American failure 15 to 2[...] this source of supply gave us no less th[...] millions value. But the intertradin[...] mother and family is already of a ve[...] well as extensive and increasing cha[...] withstanding the extreme youth, co[...] speaking, of most of the colonies. [...] indeed, are already not generally [...] remain mere producers of raw materi[...] great International Exhibition held wi[...] two years at Sydney and Melbourne, t[...] with laudable spirit, entered upon [...] competition with England and othe[...] countries in well nigh all the leading i[...] these old-established commercial state[...]

The general progress of colonial tr[...] as we have already seen in the case o[...] trading, is fairly indicated by the offic[...] and tonnage returns. Official returns [...] to 1876 of outward and inward tonnag[...] of coasting trade, exhibit alike a fa[...] business, as well as the usual feature [...] The increase for the 15 years' averag[...] cases, nearly one hundred per cent. [...] from 3·4 million tons the advance is to [...] Australia, 3·4 to 6·6; British North A[...] to 6·6; West Indies, 1·3 to 2·4. Then [...] military ports of call, Gibraltar and [...] also their considerable and progressive [...] former from 2·2 to 4·2, the latter from [...] Of this total tonnage, in these cases, t[...] tion that is British averages about two-[...]

What the one sends to the other

Turning to the merchandise account, [...] look at what this country sends to th[...] and next, at what the colonies send [...] return. With our colonies in general, [...] proportion of their exports is sent to [...] country. With the latter, on the other [...] foreign commerce still absorbs by far [...] portion—in the ratio, indeed, of as muc[...] 3 to 1. How the future is to affect this [...] be matter of experience. Our colonial

for its steadiness, not only in ts, but even in the case of each lony or group. In this respect the more reliable element to us of very noticeable falling off in our he not less abnormal increase in our the last five years, whatever it may all d it have other than a temporary or nary signification, is entirely a t a colonial irregularity. It is, how- of sufficient interest to call for some ler our fourth and last head. With ory remarks, let us proceed to glance mponents of the great trade of our may be understood that, of the given, rather more than one-fourth, e, are sent to our own possessions, foreign places.

Country sending to Colonies.

most important article in our export on, in its manifold diversities of At considerable distance, but still res, come next the varied woollen e of linen are, comparatively at tant. We have further a substantial the head of iron and steel products, clusive of that of the lighter articles d cutlery, is close up to that of the try. These three great classes of namely, cottons, including cotton s, including woollen yarn; and iron luctions, constitute the conspicuous r export trade. In 1879, they com- r a total of 103 millions out of a total of 192 millions. The cottons 64 millions, the woollens to 19½ the iron and steel to about the same. groups of less value are apparel and 8 millions, coal and fuel products nens and yarn 6½ millions, and cutlery 3½ millions.

s sending to Mother Country.

w to the other side, the chief raw our colonies for a number of years n sugar and wool. Since 1851 we ninently conspicuous in Australasia icers. More recently we have high at business in wheat and other bread- uth Australia and New Zealand, as from her boundless corn lands of Not less important, perhaps even is the prospect of our animal food y some of the advanced scientific stock production now being vigor- Australia, where ten million head of millions of sheep are already in wait-

sugar production, in spite of great me consumption, seems somewhat early the whole export comes to the 7,347,000 cwts. exported in n to only 7,878,300 in 1876. Wool wever, presents a much more lively, xtraordinary, progress. The 127 nds weight exported (also nearly all), in 1862 had risen to 413 millions ount sufficient to furnish a woollen ery inhabitant of Europe. The gold production, on the other hand, after attaining the quite surprising dimensions of 10 to 13 millions value for some years from 1851, has gradually fallen off since to only about half that amount. Cereal production is already conspicuous in Australasia, at least in the favour- able seasons of a climate somewhat uncertain for this industry. In 1879, for instance, the young and still comparatively small colony of South Australia had 400,000 tons of wheat to spare for export. New Zealand has entered upon agricul- ture and wheat growing upon farms of colossal dimensions, with all the aids of the most advanced machinery. But already it is said that the like advanced farming at Manitoba, on farms of the dimensions of an English county, must extinguish the rising Australian prospects, on account of the greater proximity to this country. I do not, how- ever, expect this result. The effect of a still con- siderable gold export in reducing homeward freights is in favour of our remoter producers. One of the earliest and most conspicuous effects of the gold discoveries in Australia was a fall to one-half in previous homeward freight rates, because the return cargo for a thousand great ships, with capacious holds full of ordinary merchandise, was only a few cubic feet of gold.

India our Chief Customer.

Our foremost figure in colonial commerce has of course been India. For the last ten years her average imports of merchandise have been 34 millions, and exports 58 millions. Of the latter about one-half comes to this country. One re- markable feature of Indian trade is the great excess in importation of treasure, chiefly silver, as compared with exportation, the respective totals for those ten years having been 91 millions and 22 millions. Besides the raw cotton already alluded to, her great opium export is only too notorious. That, however, is directed to China. It amounts in value to no less that one-fifth of the whole yearly merchandise export trade. The article jute, so useful for all rough sacking, has advanced, from less than a million sterling twenty years ago, to upwards of three millions now. Indigo is now exported to the same annual amount. There are considerable amounts of rape and linseed, rice and sugar, and already the new export article tea is up to three millions of yearly value. India, in short, with her vast population, her sixty millions of revenue, and already nearly one hundred millions of merchandise trade, gives the largest figures of our outside empire. Largely exceeding the parent in population, she makes no distant approach in amount of revenue. But India, as before remarked, is not in the proper sense a colony. The comparative vigour of pro- gress in the true colony is well illustrated in the striking fact that already the united Australasian group has a total of trade almost equal to that of India.

III.—Commercial Principles and Practice, and Tariff Relations, as between the Mother Country and Colonies.

Retrospective Glance.

We shall not readily or fully understand the very interesting and important but somewhat complex problem of the present tariff relations of

our vast and diversified empire, unless we take a considerable retrospective glance. Our colonial empire of a century past, such little as there was of it then, has altered and advanced politically as strikingly as in any of its other features. Prior to the American disruption, a British minister could declare in Parliament that a colony had no right to manufacture for itself even a nail to a horse shoe. Protection to and protection from was the reciprocal rule, until we at home expanded our views into that free trade which has been our rule of commercial government for the last thirty-five years.

The Differential Duties Act of 1850.

What still regulates fundamentally the colonial tariff system is the Imperial law of 13 and 14 Vict., commonly known as "The Differential Duties Act," but which in fact is only the section of an Imperial Act of that date for the better government of the Australian colonies. In introducing this most important measure, Lord John Russell explained that, having the previous year put an end to monoply by repealing the Navigation laws, this would put colonial as well as home tariffs on the broad free basis. The main object of the Act was to check reciprocity or protective arrangements by prohibiting differential duties. Each colony was to admit at the same duty the same kind of import from whencesoever arriving.

Colonial discussions and contention over the tariff restrictions of this Act have been ceaseless ever since, and have resulted in some modifications which I will briefly point out. In conceding constitutional self-government to the more advanced and independent colonies, the Home Government has practically allowed to each separate Colonial Government the control of its own tariff. Each colony might thus protect its own producers, but could not, in face of the Act alluded to, engage in protection or reciprocity outside, even to adjacent sister colonies.

Modifications of the Act—as to Canada.

The first vigorous movement towards a freer colonial tariff came from Canada. The tariff question was indeed a chief consideration in that other movement which in 1867 resulted so successfully in establishing the great union of British North American colonies now known as the Canadian Dominion. The Canadians complained that they were unfairly exposed, along their whole frontier line, to the closely protective system of the United States, which could flood Canada with goods by aid of our own Differential Duties Act, and yet refuse all Canadian goods in exchange. But now, by union under the one Dominion Government, the various associated colonies can interact with the freedom permitted previously to a separate colony.

As to Australia.

On this fertile tariff question, the Australian colonies were promptly in the wake of the Canadian. They claimed a good deal more, and argued stoutly for complete intercolonial liberty, and in some cases for even that of direct tariff arrangements with foreign States. The Home Government, while rejecting these views, the tendency of which, as was properly remarked, to break up the empire, is favourable, o would not be opposed to Customs unions more complete political union, between colonies, so as to give the intercolonial freedom conferred upon Canada. The A colonies had already strongly felt the co or necessity of some such union, as, for in the border-duty difficulties along t Murray between New South Wales and V

Amended Tariff Act, 1873.

In fine, there were two elaborate and spatches on the whole question from Colonial Secretary, Lord Kimberley, spectively 13th July, 1871, and 19th Ap and these, after due response from th side, resulted in the amended Imperial A May, 1873, which seems to have closed for the present upon the intercolonial t tion. Although this is only an Act "with respect to Custom duties in the colonies," yet, with the usual underst such cases, it is applicable to all like c colonies. By this Act, these Australia or any two of them, are free to n reciprocity arrangements as they please 1st, that, as regards other countries t selves the Differential Duties Act of applies; and, 2nd, that there be no co of existing imperial treaties. From it may be inferred that, certainly, th colonies of any colonial group, and p separate colonies whatever, may mak arrangements to the exclusion of t country as well as all other places, c colonies outside of themselves. Inde of 1873, still standing as it does upon t requires this most odd-looking proscr seemly as it must appear towards t country as well as others of the family.

Importance of the Tariff Questi

The whole tariff question is most in the empire's future. It is sure to be raised with reference to the diversifie flicting tariff views of our colonies. In is at this very time sitting in Lond Tariff Congress, summoned by the Can cantile interest, and representative of th of the whole empire, the avowed ai is the promotion of some reciprocity a for the empire. In one of his despa Kimberley remarks that if all the col but follow the free-trade principles n acted upon, and with such decided ad this country, all tariff difficulties would But, unfortunately, all the colonies do the matter. Most of them, indeed, hav their lot with their mother's free-trade in the younger cases, such as that of the colonies, have chiefly continued the i implanted by imperial influence at mencement; but others, and more es great Canadian Dominion, and Victo tralia, have relapsed into protection or on a variety of reasons or excuses.

On the subject of this colonial tari we have a recent Parliamentary Ret year (Foreign and Colonial Import Du

o. 120 of 1880), showing the rates of our principal colonies upon leading portation. These have, in no small tances, a protective character, more he case of the Canadian Dominion; he same time, as the report justly aties of this character are in general e as compared with those of some ries, of which a table is also given f comparison in the report. Thus ates upon certain manufactures are to 30 per cent. in the Canadas and ers of the colonies, in the United er foreign countries, they are 50 per en 100 per cent. *ad valorem* and

ction means economic or material red with the free direction of labour, es readily admitted. But it is con- colonial protectionists that social or derations are of prior consideration economic. Unquestionably they are. time, as our country from the free- int would urge, if the economic be a real fact, there ought not to be interference with free commercial for very clearly demonstrable social ecessity. We may, I think, fairly r country's experience has been to all the general interests of a people r best chance under the fullest free- s.

E CONCLUDING REFLECTIONS.

Resemblances of other Empires to ours.

three great and somewhat similar world, namely, that of Russia, that States of America, and that of our There are of course other countries, ming to be empires. But these three pecial resemblance alike in their cts, and in the problems they have in the government of remote and separate societies. With certain in all three, there is one most erence between our empire and the the latter have retained effective l to the furthest extremities respec- great areas, our Imperial Govern- tically, to a very large extent, given ol, in successive concession to the he vigorously progressive self-sup- self-governing societies which we sfully planted in almost every great world. This question has a direct th the subject of my paper; for differences, and the eagerness with ony seems instinctively to contend ariff license, are together, perhaps, st cause of this segregative action. , in its aspects alike political and forms that "colonial question" w of our future hold upon the lity spread over our grand domain, ally rising upon us here at home ; dozen of years, but which I must ter upon in the restricted limits of

The Colonial Question that "Trade follows the Flag."

But keeping strictly to the commercial part of the question, there is one section of it on which I may still offer a few remarks. We are all familiar with the phrase that "Trade follows the Flag;" and perhaps we are equally familar with the counter assertion of what is called "the Manchester school," that trade has no such partiality or nationality, and follows no flag in particular, except that of its own interests. The difference of view here is due to what makes differences in so many cases, namely, the pursuit of an abstract or deductive reasoning, without regarding the frictional surroundings of the facts of real life. The expatriated colonist, who turns his eyes back to his old home, and methodically, and as of course, sends his goods to that market, and orders his requirements out of it, is perfectly convinced that as a matter of fact, all theories notwithstanding, trade does follow the flag.

The reconciling explanation is really much simpler than most people who enter upon the question are accustomed to imagine. There is nothing more in the flag doctrine than simply the differences or difficulties of a foreign as compared with one's own nationality. There are three main obstacles in the path of foreign commerce, from which our own commerce—home or colonial—is free. First, there is the foreign element in its comparatively repellent effect; second, the different speech; and third, the different moneys and weights and measures. The whole constitute a natural "protection," tending, even for successive generations, to bring the bulk of a colony's commerce into the parental market rather than any other.

A very simple and direct illustration of the flag doctrine is supplied by the school boy who, penny in hand, is confronted for his custom by two competing applewomen. If these old ladies were exactly a match in themselves and their appurtenances, the smallest possible difference—the direction of the wind, or the matter of a half inch of distance—might suffice to determine his preference. But suppose one of the women to be a foreigner. Suppose, again, that she was unable to speak the boy's own language. Even if he had no further botheration about her foreign weights and money, he might be persuaded into accepting even the smaller apple of the two from his own countrywoman.

No doubt the "flag" effect has its limits. It may stand good at 1 per cent., and be overborne at 2 per cent. of difference. But in these days of industrial efficiency and close competition, some such small difference as the 1 per cent. may involve the whole, or nearly the whole, case. We see this remarkably exemplified, year after year, in the fact that almost every bale of our vast colonial wool clip is sent to and sold in this country, although often one-half, or even considerably more, of what is dealt with at the great London wool sales, is immediately re-exported to other countries. I cannot, therefore, agree with those, and they are still a large, although, as I am happy to think, a diminishing number, who hold that is of little consequence, commercially considered, whether or not our colonies

remain part of us. Mr. Goldwin Smith, amongst others, has told us that "Free trade wants no colonies. It can be carried on as well, if not better, with nations that are independent, as with those which have a political connection with Great Britain." All this, I reply, is only a further instance of that abstract reasoning already alluded to which overlooks experience and the facts of life.

The Imports and Exports Question—Problem of excess Imports.

Let me turn to quite another subject. Much importance has been attached to the remarkable preponderance, especially in late years, of our home import over our home export commerce. If we examine our colonial returns, and those of new offshoots generally, there is commonly excess the other way, at least after that first stage of their life during which such countries or colonies are supplied largely from outside, until they have organised their own labour. It is important to bear in mind this fact as regards our colonies, because it helps to explain the quite opposite feature of our home commerce.

I return to Mr. Bourne, who has given an unusually full and accurate explanation of a feature simple enough when thus explained, but which has puzzled and even alarmed many who had less mastery of the subject. Taking, for instance, the 20 years from 1857, the average yearly excess of net imports over net exports (that is, of imports retained for consumption, and of exports of our own produce) was about 60 millions. Mr. Bourne then explains that about one-half of this apparent excess is due to mere omissions in the method of our official reckoning, as, for example, when we omit from exports the ships and steamers we are constantly supplying to outside buyers, all of which vessels, with their stores, more especially of coal, are as real exports as anything else, and make up collectively a large yearly item. Again, there must be excess imports from wear and tear, and increasing use in the arts. And yet again, from the recorded import values we must deduct the cost of bringing the imports, a cost which of itself a careful estimate has made as much as 11 per cent.

Thus the 60 millions excess imports are reduced to about 30. But these 30 millions also entirely disappear when Mr. Bourne finds, on a balance of estimates, quite that amount to be due to us yearly as interest or dividends on colonial or foreign loans, or other outside investments. If this has not been quite 30 millions for the whole twenty years in question, there remains yet a very great deal more to be counted in the same direction. First, there are the drawings on India, which latterly average 15 millions yearly. Second, the profits of the import and export trading, as well as the freight earnings of our shipping. Third, and lastly, the earnings of our people abroad, remitted to be spent or invested here. All these credits to us must be paid in imports, and, as Mr. Bourne in effect remarks, so completely do they turn the scale, as to leave to be accounted for, not a great excess of imports, but, on the contrary, no inconsiderable excess of exports, which, as he properly adds, must still swell the outside indebtedness to *this country.*

The further and complete explanatio[n] appears to me, is found in a direction quite overlooked. It is due to the inc[lusion in] our export account by the payment [of] loans or other advances we are so co[nstantly] making to colonies, countries, or other par[ties out]side. Mr. Bourne, in short, has shown that [the] problem is not an unaccountable exces[s of im]ports, but rather an unaccountable e[xcess of] exports. The export excess, as I would s[ay, finds] its solution in a due allowance for our loans or other advances, all of whic[h must] eventually be paid or balanced by exports.

Thus we can better understand the gre[at] excess of our trading returns during our b[orrowing] payments in the earlier part of this centu[ry. Mr.] Bourne, by an estimated correction of o[fficial to] real values, finds that in the year 1816, for our net imports were only 17 millions [there was] no less, comparatively speaking, than 41 of net exports. This export excess, he g[oes on to] say, appears to have gradually abated [until] 1825, when the modern feature of thi[s] excess of imports began.

These considerations help us to deal wit[h the] remarkable figures of excess imports in [our] trade returns for the last few years. F[or the ten] years, 1871-80, the average yearly imp[ort excess] has risen from Mr. Bourne's rather earli[er figure] of 60 millions to 99 millions; and for [the last] half of that term, namely, the five year[s 1876-80,] the average yearly import excess is n[o less than] 137 millions. There is also the additio[nal feature,] so unfavourable by rule or rote to a cert[ain class of] alarmists, of a decided falling off in exp[orts, together] with decided increase of imports. As [the figures] in this way are in fact quite exceptional[ly remark]able, allow me to present them more [exactly.] Our exports appear to have culminat[ed in 1872,] when they reached a total of 315 mil[lions, and in] that year the total imports were 35[...] For the eight succeeding years the expo[rts show a] decline, until for 1880 they are only 22[...] while on the other hand the imports ke[pt increas]ing, until in 1880 they reach the un[precedented] total of 410 millions. How is this pr[oblem to be] dealt with?

Explanatory Considerations.

I utterly reject the dolorous explan[ation] indulged in, that, in such increased i[mports and] reduced exports, we are devouring our [capital in]stead of our income, and are besides be[ing progres]sively more and more expelled fro[m foreign] markets by too successful foreign ri[vals. The] facts of our business life, present as w[ell as past,] are entirely opposed to both these c[onclusions.] Certainly there has been no such cha[nge in our] spending habits during these last eig[ht years as] to make us now utterly disregard the li[mits of] our earnings. On the contrary, our [statisticians] still calculate, on sound data, the many [millions of] the annual savings of the country; and o[ur income-]tax returns are standing proofs in the [same direc]tion. No doubt our distinguished Pre[mier, in his] Budget speech last month, laments [that the] income-tax, which had rolled up with [such] huge steps from £750,000 a quarter [of a century] ago, to £1,990,000 for each penny for the years 1877-8, should, three y[ears]

› be estimated at only £1,943,000. Well, so But the smaller amount is hardly one whit fective than the larger in overturning our sts' views. By way of accounting for this check and reaction, most of us may still ct some exposures of hollow trading towards d of 1878, the most prominent instance ich was the notorious City of Glasgow

l, we are left to explain, in some other and r way, the features in question. I have y alluded to a comparatively unnoticed e—the increase due to our exports from our g, from time to time, great outside pay- . I have now to notice a feature just the te, and almost equally overlooked, namely, ect upon our imports of any great repay- of such principal sums. We have been ing largely such repayments of late, in lar from the United States; while further, tending to the same effect, namely, that of ing our imports and reducing our exports, France and the States are beginning to com- ith us in supplying the poorer outside world pital.

United States, as is well known, have making most strenuous and exemplary to reduce or extinguish the great public queathed to them by their civil war, and s been especially the case during the last three years. Great part, probably the part, of these repayments, have come to intry. As bearing me out in the general hich I have been presenting, let me give r import and export figures of the States. 7 the imports are 98 millions as against 122 millions; for 1878 they are respec- 6 millions, and no less than 145 millions; 9, 103 millions and 151 millions; and for spectively, 139 and 178 millions. These y startling figures, equally so, indeed, with a in the exactly opposite direction; but both re equally explicable on the principles I ndeavoured to lay down. They are not rily the indication respectively of either rofit to the one country or great loss to the If we have received of late unusually great its, thereby swelling our import figures; we have used these largely to improve our state, instead of sending them again abroad, r tending to comparatively reduce our , we may not, by such occasional variety in nomic procedure, be promoting less than at imes the general well-being.

ture as to Mother Country and Colonies, and its Feature of Accelerating Progress.

re now but a few words, in conclusion, upon ature of our progress, or more properly of celerating progress, which I have already dly referred to. Dr. Benjamin Franklin, ring of instances of long suspended life in , expressed the wish that his own life could s suspended for a hundred years, in order might see the expected great progress of ntry. That hundred years has just passed; the patriot philosopher could now return to the advance of his great country, it would ly far surpass even his most sanguine antici- pations. Again, it stands recorded of our postal service, and the record is so little removed from us as to be found within the preceding century, that the mail from Edinburgh to London conveyed, on one occasion, but one letter. What would a Franklin *redivivus* of those small postal times say now, or how could he possibly have anticipated the aspects and dimensions of a modern mail between the two capitals!

If we are to judge by the past, and more especially the recent past, the waking up to a further century of progress would present a vast advance, as well as a marvellous change of aspect, as compared with even the present great attain- ments of our empire. If the empire is still, as we all hope and wish, to hold together, and this, with due care and precaution, where all parties are so agreed, ought not to be impossible, we may expect that even the short space of a century might pro- duce incalculable changes. Prior to the present age, a century did not very much alter any part of the world, even if our comparison include the best and most progressive days of ancient Rome and Greece. But in a further hundred years, at the apparently geometric acceleration of pace upon which we have entered, what may be the aspects and progress, for example, of the great Canadian Dominion, of the almost boundless expanse open to the Cape Settlements, and, more perhaps than all others, what the advance and change of the Australian colonies?

The mother country's progress may continue the marvel we have just alluded to in her postal business; but she will certainly be far surpassed by the relatively quicker progress of most of her colonial children. In the *Statistical Journal* of last year (1880, pp. 491-4), Mr. Price Williams has given us some curious results of the estimated future population of this country. Going much beyond a mere hundred years, he finds limiting causes which will prevent Great Britain, for instance, with its present 29 millions, having more, as far on as A.D. 2231, than 132 millions; or upon another and more hopeful calculation, 176 millions for the year 2181, or three centuries hence; while London in the same time is to rise from 3,700,000 to only a little over nine millions. My own idea would be to extend very greatly this calculation, even for our parent State; for in these days of enterprise and progress people will be born into the world, and once there they will contrive to keep themselves alive and comfortable by aid of all the science and the business facilities and resource of their day, and they will again quit the world only to leave families of still greater numbers behind them. But in any case our colonies' progress is not restrained by any of the narrower circumstances that may be supposed to tell against their common parent. Those of us to- day who, as Franklin did last century, enjoy a mental excursion into the future, have there a free domain before them, and an assurance that they can hardly be too sanguine in their expectations and estimates. Let us hope that our great grand- children, who are actually to realise all our present guesses, will still look upon a united British Empire, which is destined rather to be held more firmly together, than to be disunited into frag- ments, by the accumulating weight of its great future attainments.

DISCUSSION.

Mr. Stephen Bourne said this subject was one of immense importance, and he believed it would grow until it forced itself on the attention of economists and statesmen to an extent at present not dreamed of. The progress of other nations, as well as our own, was a point which required to be borne in mind, for there was no doubt that both France and the United States were increasing in the amount of their trade more rapidly than we were. This was not a thing to be mourned over, for if we believed that trade was good for us it was good for the rest of the world, and we could not be surprised at younger nations overtaking us, and by their own progress adding to the general welfare. At the same time it was very important that we should not go backward or neglect opportunities for further progress. He quite endorsed what was said in the paper as to the contrast between official and real values, and was glad to think that the allusion to the subject would lead statisticians and economists to see the danger of contrasting the figures of the present day with those of many years back, without understanding the difference between them. If one took the price of bread or meat in the time of Queen Elizabeth, and compared it with present prices, it would show how fallacious a comparison founded on money value must be, if uncorrected by the quantity of the article referred to. If this were not attended to, statistics, as had been said, might be made to prove anything, whereas, if treated honestly, and with due information, they were most valuable. He thought Mr. Westgarth had rather underestimated the amount of our colonial as compared with our foreign trade. The fact was our colonial trade, both export and import, had been growing more rapidly than our foreign trade. This was a satisfactory feature, because it was of very great importance to keep up our trade with those allied to us, and it showed the advantage of our efforts in aid of colonisation. It was quite certain that trade to a great extent followed the flag, but he did not attribute this altogether to attachment to the flag. No doubt that had an influence, but in addition to that a colonist had greater credit in his native country than elsewhere, and colonial trade grew up principally on credit. But whatever the truth might be, the fact formed a very good reason for endeavouring to promote emigration to our own colonies rather than to the United States. A friend of his in those States recently suggested to him that it would be a good speculation to invest in some of the land companies there, and no doubt money was to be made in that way, but whatever his ideas of the wisdom of such an investment might be, he could not consistently assist emigration to the United States in preference to our own colonies, whilst the former acted in such a hostile manner towards us in respect to the tariff. Canada was now doing something of the same kind, but he hoped she would soon see the wisdom of making a change. He could not recommend anyone to emigrate to a colony which did not establish perfect free trade between herself and us. He had some later figures than those quoted by Mr. Westgarth, showing that in 1880, out of a total trade in cottons, woollens, and iron goods, to the amount of 223 millions, 124 millions were with the colonies. That being so, one could readily understand how any depression in those three great branches of trade was felt so extensively throughout the whole country. It was impossible to over-rate the importance of the tariff question, and his decided opinion was that the true solution was only to be found in the mother country and all her colonies having one uniform tariff, both for customs and excise duties. The man who took his drink of brandy in Norfolk paid the same amount to the revenue as the one who drank brandy in Middlesex; and he held that the man in Canada, or Australia, should do *the same.* If the colonies required to raise a larger *revenue,* they should do so in some other way. That would be a better system than to endeavo[ur to per]suade the mother country to allow the [colonies to] impose protective duties against herself an[d the] world besides. However much clamour [might be] raised in support of such a scheme, he [did not] believe Englishmen would ever retrace thei[r steps in] the matter of free trade, and he was q[uite sure] that if they did, such action would soon [give the] death-blow to English commerce. With r[egard to] the vexed question of imports and exports, M[r. West]garth had correctly stated the gist of the q[uestion as] he had himself laid it down some years ago, i[n a paper] read before the Statistical Society. Th[ere could] be no doubt that the average excess of 30 [millions of] imports over exports was reducible to about [...] and it was fully accounted for by the receipts [we] had from our investments abroad, and th[e freights] earned by our ships in carrying the goods. [The] object of the paper from which these parti[culars had] been extracted, was to show that althoug[h such had] been the state of things in times past, it [was now] entirely altered. In the earlier history of ou[r commerce] we exported largely in excess of our im[ports, and] though no doubt the maxim of Adam S[mith, that] whatever a country imported must be paid [for by its] exports, was true, it was true only over a lo[ng series of] years; it did not follow that it was true in [each year,] or that circumstances might not be cha[nged. The] object in that paper was to point out that w[hen we had] a preponderance of exports we were not in[...] because we were making loans to the c[olonies and] foreign countries. For instance, when the U[nited States] was developing her railway system, we s[upplied her] largely with railway iron, but we took [in return] American bonds and securities; and hence [we were ex]porting largely without any apparent retu[rn, but] making America our debtor, and held a [mortgage on] her property. At that time we were growi[ng most of] the food we needed, but now we grew mu[ch less than] we required; America was supplying us [with it, and] we were paying her, unfortunately, not w[ith our ex]ports, but by writing off her obligations to [us. He had] no doubt whatever, that for a series of ye[ars America] had been rating up her capital to the e[xtent of many] millions a year, and America had been pa[ying off her] debt by the food she had been sendin[g us. The] drain of gold which some people [...] would not set in until America ha[d redeemed] all her bonds and other securities [...] held in this country, but when that [time came,] if the present state of things continued [we should] be drained of our gold to pay for the food [...] That was the view he expressed some seven y[ears ago, and] he had seen no reason to alter his opinion si[nce. At the] same time he did not take a dolorous view o[f the future.] The result depended on the wisdom with wh[ich ...] If a man with a large family, who found it di[fficult to earn] bread and butter for them all, allowed the[m to remain] in idleness, or spending their time in painti[ng] or adorning the garden, instead of earnin[g ...] should tell him he was doing wrong—[consuming his] capital—and that the only result could be [...] And it was just the same with a country; [if we went] on spending more than we were earning, th[ere could be] but one end. The large excess of imports had [consisted] entirely in articles of food; and if that food [was converted] into human muscle, to be employed in ma[nufacturing] goods for export to pay for it, he did not car[e how much] food was imported; but if, on the other hand [the labour] the food supported, either could not find e[mployment,] or was devoted to unproductive purpose[s, we were] living too fast. What we wanted was to i[ncrease our] trade, and if foreign countries were ceasin[g to trade with] us, we had a grand resource in our colo[nies. Every] economical consideration showed that we [should use] every means to stimulate emigration to ou[r colonies,] thereby saving the lives which we were de[...]

ig and unsanitary arrangements, and at the
aising up customers, and enlarging our own

rewater said Mr. Bourne's conclusion seemed
nlimited free trade would be a very good
y we had a condition of things which was
o occur. He congratulated Mr. Westgarth
er, which some years ago would, no doubt,
xceedingly satisfactory, but, at the present
were many things which tended to show
rade was not such a universal panacea as it
presented. It appeared from the paper that
as improving in her commercial prosperity,
isly with England's decline, and the question
r America was right or England. It was a
s thing that the two greatest Republics in
ltogether refused to adopt the teaching of
ester School, and went in for protection.
both flourishing, but in England, Consols
par, land was greatly reduced in value, and
re all complaining that they had lost their
ractically, the money was being drained out
ry. Working men had cheap food, but they
ges, and they were beginning to see that it
o have the loaf at 1s. with money to buy it
if they had no money. The question was
means so clear as it was represented, and it
ubtful whether an exactly opposite system
o be adopted.

rman said he hoped succeeding speakers
go further into the subject of free trade, but
subject of the paper.

liam Botly said he would attend to the
request, although he had never heard
fallacious or opposed to common sense than
unded by the last speaker. The paper was
irable one, and it was very important to
what good customers for our manufacturers
our colonies. Only a day or two since, he
ment from Melbourne to the effect that the
ts from Melbourne, Adelaide, and Sidney,
month to Great Britain had been:—Wool,
s; tallow, 4,800 casks; copper, 900 tons;
900 tons; wheat, 53,000 qrs.; flour, 75,000
22,000 ingots. He had as much correspond-
he colonies as most people, and the letters
ived within the last few days, fully corrobo-
iews of Mr. Bourne. In Canada there was
d for agriculturists, if these had skill, capital,
ise, but helpless waifs and strays who would
n on any country were not wanted. It
mpossible for England to do without free
though he was a small landowner himself,
ay that if landowners demanded protection
e of increasing their rents, they ought to be
nto the sea.

scombe said it had been clearly shown that
ries which had not followed England's free
y, had made more rapid progress. At the
ment, England had the whole world against
ostile tariffs, and the question was where
a future to obtain a trade, by which to pay
d which she required. It appeared to him
ght so to legislate as to induce our children
from the home country to the colonies,
ritish land, under the British flag, might
corn required, and that we in return
l our commerce increase. He could not
a Mr. Bourne, that a uniform tariff for
ain and all her colonies ought to be in-
there might very well be differential duties
lonies which required to raise more revenue
own purposes. Everyone would agree that
rith the colonies should be fostered and pro-
r as possible.

Mr. Clements said he had never listened to a paper which had given him more satisfaction than the present. He thought all countries should have perfect liberty to adopt any fiscal system they pleased. This country had obtained considerable advantages by free trade, but these had not been unqualified advantages, and concurrently with its introduction had come the development of the railway system, and other matters which were great factors in the increase of English commerce. The excess of imports was, no doubt, due to the increase of population, being principally in articles of food, the English farmer not being able to compete with the American in the growth of corn. He thought English farmers should turn their attention to other kinds of produce, such as milk and vegetables, which would pay them better.

Mr. Cook said he would not now speak of free trade, but he thought that at some other time it might very usefully be discussed. He should like to know, when it was said that the excess of imports consisted of payments for investments in foreign countries, whether it was merely the interest we were receiving, or the capital; if the latter, what was done with it? If we were paying for our food with it, we were certainly living on our capital.

Mr. Trelawney Saunders could not miss the opportunity of impressing on the public the importance of the colonies to this country, and of this country to the colonies. With regard to the doctrine of the flag, he could not imagine a stronger instance than the trade we did with the United States—people of our own race and language; in consequence of this question of the flag, we exported less there than to Australia, although the population was twenty times as large. The colonies were necessary to this country if we were to rely on our own soil for our food. Without enlarging upon the vexed question of free trade, he would venture to remind the gentlemen who spoke so despairingly of the present condition of things, that within his own memory there was not a farmhouse where the men did not eat barley bread; now such a thing was unknown, and the conditions of society had improved in like manner throughout. A remark had been made that they must be careful in all their discussions to avoid politics, and he quite agreed that they should not go into party politics; but until a question became one of party it ought to be open to them, and it was impossible to consider colonial questions without looking at their political aspects. The question of tariffs could only be settled on the basis of common legislation at present, because the colonies were not represented. Until that was done, it was no use talking about intercolonial or international tariffs. He hoped some opportunity would be given, either in that Society or elsewhere, to consider the manner in which a union of the colonies and the mother country could be brought about. It was a question which could not be allowed to slide, for every day personal interests were growing up which constituted obstacles in the way of union. The only centre from which union could be brought about was the mother country, because Australia and Canada would not of themselves see any necessity or advantage in being united with each other. The colonies owed their existence and protection to us, and he thought they would be willing to take their fair share of the burden and responsibility. He felt sure that a severance of the colonies from the mother country would have the same effect as the breaking up of the old Greek republics; we should simply become the prey of the common enemy.

The Chairman said they would all agree in the importance of the colonies to the mother country. It was the rule here not to go into political questions; but, as had been said, it was quite impossible to deal with such a question as the colonies altogether apart from it. He begged to propose a cordial vote of thanks to Mr. Westgarth for his extremely interesting and valuable paper

The vote of thanks having been carried unanimously,

Mr. Westgarth, in reply, said time would not admit of going at length into the many questions that had been raised; but he thought Mr. Bridgewater, like Mr. Ruskin, regretted these times of hurry and progress, and would like to go back to the old sylvan days, when everybody sat quietly under his own fig-tree. He would only say to him, that one of the favourite arguments of Protectionists was, that in England wages were so high, that the manufacturer in this country required protection against lower wages elsewhere.

TWENTY-FIRST ORDINARY MEETING.

Wednesday, May 11th, 1881; Lieut.-Colonel DONNELLY, R.E., in the chair.

The following candidates were proposed for election as members of the Society:—

Betts, Edward Peto, M.A., The Holmwood, Bickley, Kent.
Clark, Robert Ingham, West Ham Abbey, Stratford, E.
Cottrell, James Maskall, 340, Brixton-road, S.W.
Glover, William, Tower Chemical Works, Victoria Docks, E.
Grant-Duff, Malcolm, Imperial-chambers, Bowlalley-lane, Hull.
Treloar, William Purdie, 69, Ludgate-hill, E.C.

The following candidates were balloted for, and duly elected members of the Society:—

Allison, Herbert John, 41, Southampton-buildings, Holborn, W.C.
Baggallay, Henry Charles, 4, Ada's-avenue, Hull, Yorkshire.
Blakesley, John Holmes, M.A., 23, Fopstone-road, South Kensington, S.W.
Elliott, William St. George, M.D., 39, Upper Brook-street, W.
Favarger, Henri, 75, Turnmill-street, E.C.
Heseltine, Francis J., Westminster Palace Hotel, Victoria-street, S.W.
Inglefield, Admiral Sir Edward, K.C.B., 99, Queen's-gate, South Kensington, S.W.
Keefe, John, Colquitt-chambers, 6, Colquitt-street, Liverpool.
Longworth, William, Guildford, Surrey.
Matthay, George, F.R.S., Cheyne-house, Chelsea Embankment, S.W.
Ramsden, John Carter, Gristhorpe-hall, near Filey, Yorkshire.
Ravensworth, Earl of, 9, Mansfield-street, W.
Severn, Walter, 9, Earl's-court-square, S.W.
Snape, William, J.P. (Mayor of Over Darwen), Lynwood, Darwen, Lancashire.
Sproston, Hugh, Hughville, South Norwood, S.E., and Demerara.
Thornton, Edward, C.B. Bank-house, Windsor.
Warren, W. J., Cotford-villa, Bournemouth.

The paper read was—

THE MANUFACTURE OF GLASS FOR DECORATIVE PURPOSES.

By H. J. Powell, B.A.

"The manufacture of glass for decorative purposes" is a subject of considerable extent, and requires more time to do justice to it than is at present available. The subject may conveniently be divided into three parts:—1. The d for decorative purposes of the natural glass; 2. The production of decorativ decorative material, by the manipulati in a plastic or viscous condition; 3. Tl of the surface of glass with a view to the effects due to its form or its nature

I.—NATURE OF GLASS.

Glass is defined as an amorphous solid, and the existence of devitrified g is both crystalline and opaque, and of c glasses to which I hope to allude materially damage this definition. Th different glasses, but all agree in being compounds which are called silicates being formed by the union of the oxid or silica, with another oxide. The lar silicates may be divided into two grou being composed of alkaline, and the c metallic silicates. It is only necessary a few individuals belonging to each of t namely, those of the first group, w tively contain the oxide of potassi oxide of sodium, and those of the se contains the oxide of lead, the oxide and the oxide of barium. Every contain at least one silicate belon group of alkaline silicates, as well as belonging to the group of metal Manufacturers have practically nothin silicates as silicates, but knowing th of a glass depends upon the natur stituent silicates, they put into th materials of such a nature, and in suc as will produce the silicates, and cons glass which they require. The raw m as a rule, oxides or carbonates; a car a compound of an oxide with the ox or carbonic acid. The most importa are sand (an impure form of oxide o lead (a mixture of the oxides of le carbonates of potassium, sodium, bari cium. The whiteness of the resultant upon the purity of the raw materials, a upon the absence of iron, whether as as a metal. The silicate of lead is fo direct combination in the crucible influence of intense heat, of sand with lead. The silicates of potassium, sod and calcium, are also formed in the cr indirect action of the sand upon tl carbonates. This indirect action co expulsion of carbonic acid gas from t by the intensely heated oxide of sil consequent union of the latter with oxide. Given the alkaline and meta required to form a certain glass, the m materials for the required silicates taneously thrown into the crucible, and will be simultaneously produced by t the heat of the furnace in which the previously been "set."

The simplest form of a glass furnac base, covered by a flattened dome. I of the base is a comparatively smal round the grate, under arches forme of the dome, the crucibles are placed. through the dome at the side of each direct upon the crucibles the heat a

he centre of the dome. The arches introduction and removal of crucibles the removal of glass from the cruci-

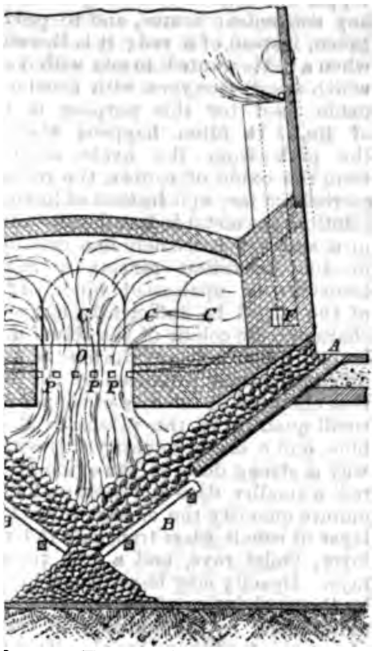

FIG. 1.—FURNACE.*

quired for manipulation. Crucibles e-clay roll by roll, and their shapes according to the nature of the mix- they are intended to hold. If the mixture for a glass contains oxide of lead, it must be protected from the reducing action of flame, and the crucible must be closed on all sides, except where no flame can reach. Mixtures containing no oxide of lead are exposed in large open fire-clay bowls to the full action of the flame and heat of the furnace.

Different glasses possess different qualities, according to the number and nature of their constituent silicates. As a general rule, a glass containing two silicates is less fusible, but considerably purer in colour and texture, than one containing a larger number. A homogeneous glass is more easily obtained when its constituent silicates are of similar or approximate specific gravity. Plate and sheet glass, composed of the silicates of sodium and calcium, are generally homogeneous, but possess a green tinge, due to the silicate of sodium. Crown glass is white, owing to the replacement of the sodic silicate by silicate of potassium. Flint glass, consisting of the silicate of lead and silicate of potassium is both white and brilliant. The brilliancy of flint glass is due to the density of the lead silicate, but this very density is frequently the cause of striæ and irregularities in the substance of the glass. It is almost as difficult to obtain a clear mixture with the silicates of lead and potassium, as with water and oil. The silicate of barium is used for pressed glass, as a cheap substitute for the silicate of lead. Venetian glass contains three silicates—namely, those of sodium, calcium, and potassium, it is therefore fusible, and its density is trifling. To these two properties the lightness and intricacy of Venetian work are to be attributed. Venetian glass is generally devoid of brilliancy, and very far from being either white or homogeneous, but these very deficiencies give that horny effect which is looked upon as a characteristic beauty.

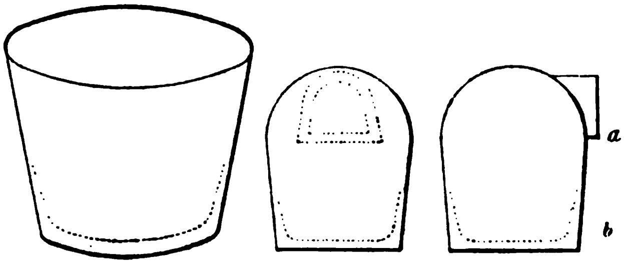

FIG. 2.—CRUCIBLES.

ass, in addition to the silicates of sium, and calcium, contains traces s of magnesium and aluminium. It ly manipulated, and developes, with of copper, a ruby colour, which can- d with a glass containing silicate of

n and purification are complete, the crucible is in a condition closely at of very glutinous treacle. It can from the crucible by pouring, by by gathering. Gathering consists the heated end of a hollow iron rod, measuring from 5 to 6 feet, into the molten mass, and turning it so as to collect a coil of the semi-liquid material. It requires some skill and practice to collect the exact weight of glass required to reproduce a given pattern, especially as a mistake in this, as in all processes of glass manufacture, is irrevocable. The molten glass, as it comes from the crucible, may be considered to be physically porous, as heat produces mutual repulsion between the molecules of a body. These physical pores have to be closed by a very gradual process of cooling, for if the process be hurried, the outer crust will be solidified, whilst the interior remains in a porous condition. So-called toughened glass has failed, because however hard the surface may

ed to illustrate this paper have been kindly lent nd Co.

be rendered by the violent contraction caused by sudden cooling, the interior remains porous, and the unnatural tension excited between the interior

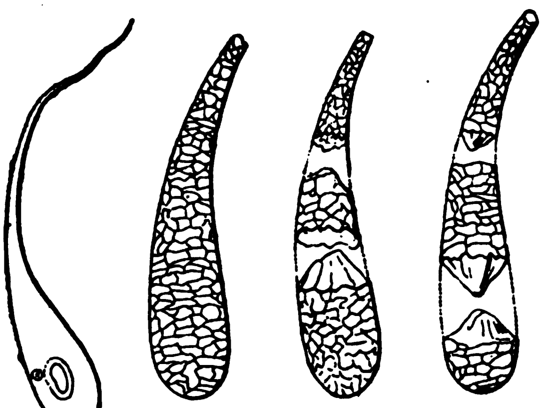

FIG. 3.—PRINCE RUPERT'S DROPS.

and the surface generally ends in the destruction of both. Gradual cooling, or "annealing," is practically effected by placing the glass-ware immediately after manipulation upon movable trays, and slowly removing them in a continuous train from a constant source of heat, or by placing the ware in a heated oven or kiln, and allowing the source of heat to die out.

The effects produced respectively by the refraction, transmission, or reflection of light by glass may, in many cases, be utilised for decorative purposes. If a beam of light be transmitted through a glass prism or lustre, a more or less extended spectrum is formed in proportion to the density of the glass. If white light be transmitted through glass containing the oxide of uranium in solution, rays otherwise unseen become brilliantly conspicuous. If certain metallic oxides be introduced into a crucible, together with the mixture for transparent glass, and be dissolved throughout the mass, the resultant glass acquires the power of sifting the incident rays, and of transmitting effects of colour, according to the nature or quantity of the oxide introduced. Different permanent transmitted colours are obtained (1) by the oxides of different metals, (2) by the different oxides of the same metal, (3) by different quantities of the same oxide, or by different thicknesses of the resultant glass. The characteristic colours of the oxides of gold, silver, copper, manganese, iron, and cobalt are, respectively, pink, yellow, peacock-blue, violet, dull green, and purple-blue. Copper and iron possess two oxides each, namely, a peroxide containing a large proportion of oxygen, and a sub-oxide containing a smaller proportion. The peroxide of copper gives a blue or green colour, and the sub-oxide a ruby red. The peroxide of iron gives a yellow, and the sub-oxide a dull green. Certain oxides are valuable for their power of respectively increasing or diminishing the oxidation of other oxides. Thus, to obtain an iron yellow, which is the characteristic colour of the peroxide of iron, it is necessary to add to the mixture oxide of manganese, which, at a high temperature, parts *with its oxygen* and its colouring power simultaneously. The oxygen thus set fre the assistance of the peroxide of ir has a tendency to part with it and to produce a green colour. The s copper has a great tendency to rob ox any convenient source, and to produce green, instead of a red; it is therefore when a red is wanted, to mix with it som which absorbs oxygen with greater av oxide used for this purpose is the of tin. It often happens that in the pink from the oxide of gold from the oxide of copper, the reducti carried too far, and instead of having t solution, the metal is found suspended i in a state of extremely fine division. in this condition reflects a red c transmits an opalescent blue. If th of the metal be sufficiently large to characteristic colour of the actual meta known effect of avanturine is obta different colours produced by the sam best observed in the case of copper and small quantity of the per-oxide of co blue, and a larger quantity a green. way a strong dose of the oxide of co red, a smaller dose a violet, and a co minute quantity the characteristic blu layer of cobalt glass transmits red ray layer, violet rays, and a still thinne rays. Opacity may be produced by de by the semi-fusion of pulverised white glasses, and by the addition to trans of some infusible material. Devitri never been pressed into practical use fusion of pulverised glass places at the disposal a material of great strength, granular and irregular surface, togeth power of developing almost every tint an absolutely permanent condition. is also valuable to the manufacturer, a means of utilising waste. Opaque bl black enamel is formed by the additio parent glass of an excess of an infusibl fusible black oxide, as, for instan iridium, of cobalt, of manganese, or of and coloured enamels owe their opa oxide of arsenic, the oxide of tin, the calcium, or to cryolite, a compound aluminium, and fluorine, and their different metallic oxides. It is cryolite the opacity to the well-known hot celain, good specimens of which have lent by Mr. J. G. Sowerby, of Gateshe

II.—MANIPULATION.

The molten glass gathered on the hollow blowing iron may be placed and by the pressure of a workman's b inner surface, may be forced to ada internal and its external surface to t surface of its environment. By thi glass may not only receive the actual interior of the mould, but may also be by any depressed or raised ornament, its inner surface. If instead of being the workman's breath, it be forced to to the mould by the descent of a plu assume on its outer surface the internal mould, together with any decoration wh

pon it, and on its internal surface the urface of the plunger.
ten glass may also be fashioned by the l the simple tools of the glass-blower. of the chair in which the workman he hollow and solid rods by which he rotates the glass with his left hand, the entire mechanism of his lathe. pal tools are what may be called the spring tool, the shears, the battle- ttening tool, together with a variety of s, measure sticks, and calipers. How- e the tools may be, the variety of a blown bulb may be forced to assume tible. The molten glass, when gathered ıcible, is too fluid for immediate manipu- requires to be partly solidified by rol-

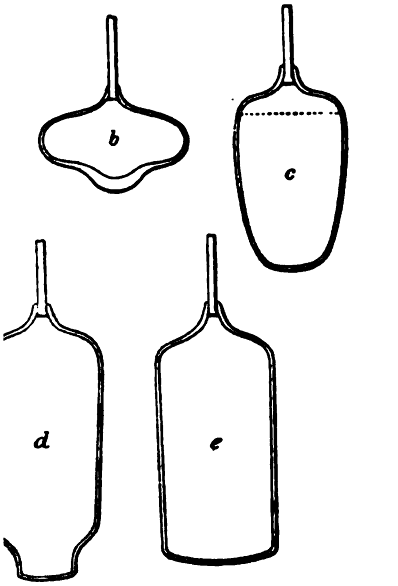

FIG. 4.—SHEET GLASS.

polished iron slab, or by insertion in wooden cup-shaped moulds, from which ay assume a rough outline of its ulti- The first process in every case is blow- h the hollow gathering iron until the ss be expanded into a bulb. If the iron tically, with the bulb downwards, the gated by gravitation, and expanded at me; if the bulb be raised and blowing d, it increases in circumference only. nay also be elongated by gravitation ted by a swinging motion. Whilst the ıg shaped with the spring tool, it must n constant rotation by rolling the ıich it is attached upon the arms r, as otherwise it would collapse. If f the bulb, remote from the blowing opened, and the bulb be rapidly heated simultaneously, it will suddenly r centrifugal force into a flattened disc. be re-heated, and the iron held perpen- vith the disc downwards, the disc will rumple and collapse. The heat required to renew the plasticity of glass essential to manipulation is obtained by inserting the bulb or vessel into the mouth of a heated crucible, or into a furnace adapted to the purpose. If to the end of a solid mass or hollow bulb of glass a second working rod be attached by a seal of glass, and the workman recedes whilst retaining the blowing iron, and an assistant recedes carrying the second rod, the bulb or mass which unites them may be indefinitely extended. If a connection be formed be-

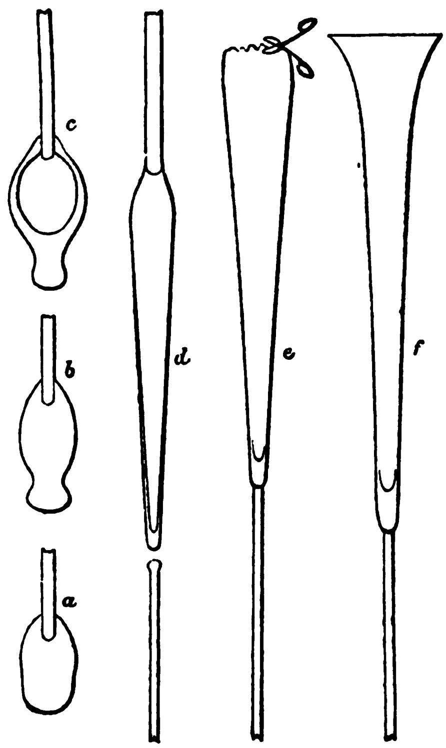

FIG. 5.—LONG VASE.

tween a source of molten glass, and the circumference of a heated wheel, and the wheel be caused to re- volve with speed, a thread is coiled upon the wheel in an extreme state of tenuity. This thread may be spun into a decorative fabric.

III.—TREATMENT OF SURFACE IN ORDER TO SUPPLEMENT EFFECT DUE TO NATURE OR FORM.

Decorative surface obtained by blowing into moulds.

Venetian sheet glass.
Ribbed and diamond moulded table glass.

Decorative applications to surface by heat.

1. Coloured and metallic gems, seals, and frills.
2. Etchings in gold leaf.
3. Sections of variegated cane.
4. Threading, imitation leaves and feathers, and various forms of threading.
5. Reticulated enamel ornament, with bubbles.
6. Metallic, coloured, and scale decoration.
7. Frosted glass.
8. Iridescence.

Decorative applications without heat.

1. Iridescence by corrosion and decay.
2. Cutting.
3. Engraving.
4. Sand-blast process.
5. Acid.
6. Carving. Specimens lent by Mr. Thomas Webb, of Stourbridge Glass Works, Stourbridge. The origination of the process is due to Mr. Northwood.
7. Enamel painting and gilding, fixed by heat.
8. Mosaic transparent glass.
9. Mosaic opaque glass.
10. Stencilled opaque glass.

Such are a few of the processes now u the manufacture of glass for decorativ Additional and improved processes will be introduced as long as the demand for glass continues. The style of the produ flint glass manufactories has so complete in the course of a few years, that it is foresee upon what lines the manufact future is likely to run. The change is dicated by the fact that whereas flint almost entirely sold by weight, sale by at the present time an exception. T

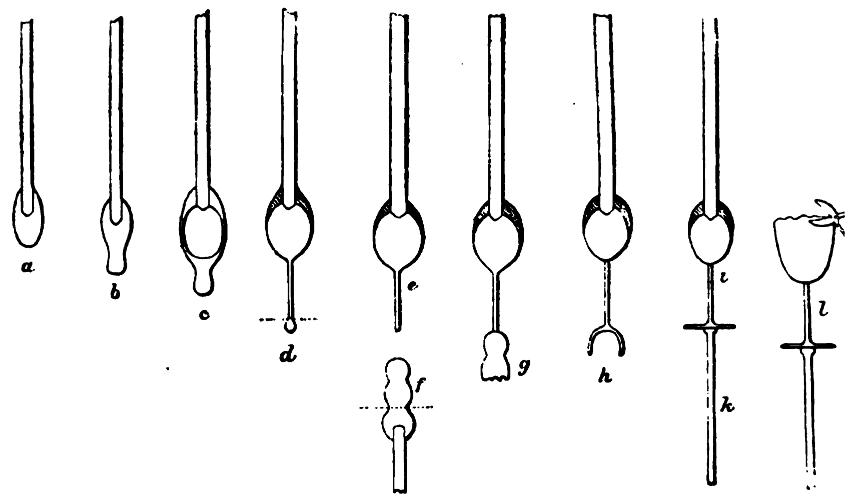

FIG. 6.—WINE-GLASS.

indicates a loss of a staple product, namely, the heavy ware of medium or common quality. The majority of this ware is now produced on the Continent; the remainder has been retained in England by the perfection of the material of pressed glass, and of the mechanism by which it

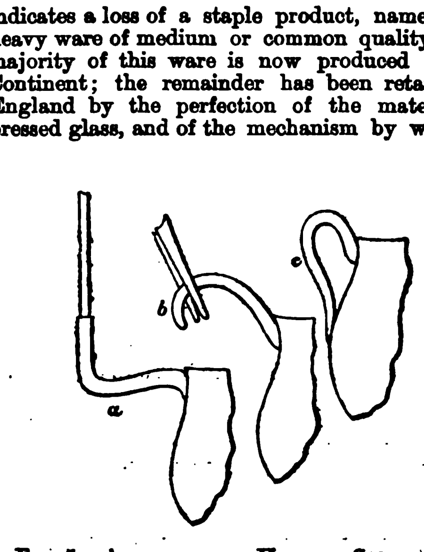

FIG. 7.—APPLICATION OF HANDLES, SCROLLS, &C.

is produced. Pressing glass is a manufacture by itself, and the loss remains to the workmen and manufacturers of flint glass. Decorative glass has taken the place of that which has been lost, but it is doubtful how long it will be possible to produce it with profit, considering the increa competition. English flint glass n are now mainly turning out the be table glass and decorative glass, an profit depends upon the invention of of novelties. The only safeguard o branches of manufacture is to adopt style and an English standard. The be determined by consideration of the vessels produced, and of the nature of It is, for instance, undesirable to longed labour upon the decoration of is essentially fragile. The forms an of the wares produced must be elegan and every care must be taken to devel due to the natural properties of the m standard must be the highest possi vessel should be allowed to leave the s which is not perfect both in materia manship.

Effectual assistance in the competit may be derived from the adoption methods of working and the applic proved knowledge and of greater econo out all the processes of manufacture. it will be advantageous if workmen facturers can discover that their tru identical. The Flint Glass Makers' So and has made mistakes; but these m no valid reason for antagonism, and t are due the increased sobriety, intel productive capacity of the workmen

DISCUSSION.

. Chairman, in inviting discussion, said he hoped Webb would give some further information on this subject.

. Webb said he should have been happy to say thing, but really there was nothing to add to the full information which Mr. Powell had given.

. Clements said he was not practically acquainted the manufacture of glass, but had done a little at an amateur, and had often witnessed the marvellous with which the glass-cutter could tell whether the of a piece of glass were of uniform size without ument. Some time ago he endeavoured to get up teur society in the City, one of the objects of which practice glass-blowing, metal and wood turning, but, unfortunately, the scheme fell through. With to the colours which had been mentioned. When ist oxides were treated by various re-agents in a ube, the different colours would be seen, produced rays of light passing through the substance. It ell known that colour was caused by certain rays t being absorbed, and others being allowed , or being reflected. If all the rays were reflected mitted, the colour was white; if they were all d, it was black; but if some only were absorbed, ainder would cause the colour. He understood reign competition was very severe in the glass ut that was the case with many other trades as The sand-blast was shown in operation at the xhibition at South Kensington some years ago.

Chairman said that as there seemed to be inclined to discuss the subject, he must con- ie proceedings by proposing a vote of thanks reader of the paper. He must say he was prised that there was no discussion, for he paper was so full of matter, that they yet been hardly able to sort it in their There was, as Mr. Powell had told him oming in the room, enough matter in the paper e lectures. As far as he was concerned, one ar idea brought home to his mind was, that at nts, we had here a manufacture with which, he present time, machinery had little to do. e saw the rough tools with which the beauti- cles were made, he thought that even Mr. might find some pleasure in contemplating the nanufacture. There did not seem to be ortion of the subject in which machinery ervened, except in that one process of the ast; and it was certainly some satisfaction to t there was still one branch left in which real aft skill had to do the largest portion of the and they could all reciprocate the wish which ader of the paper had expressed, that they have an English style, and that this industry, was of enormous importance, should prosper country. They must all agree with him that the best chances of its succeeding, would be workmen and manufacturers to come to the ion, and to act upon the conclusion, that nterests were identical. He did not know ere was anything so likely to conduce to l, as when a large employer of labour spoke as well had spoken, of the society which came arly within his purview, the Flint Glass Makers' , and when they found that the manufacturer treating the trade society as an opponent, but full credit for all the good which it could and He was sure they owed a hearty vote of to Mr. Powell, for the admirable paper he had

vote of thanks was passed unanimously, and the ings terminated.

MISCELLANEOUS.

TECHNICAL COLLEGE.

The first stone of the City and Guilds of London Technical College, Finsbury, a building adjoining the Cowper-street Schools, was laid on Tuesday, 10th inst., by H.R.H. Prince Leopold. The classes of young men, previously held in the schools, were attended in 1880 by 422 students, and related chiefly to applied physics and chemistry. The new college will be a plain building in classical style. It will contain 32 rooms, comprising a large laboratory, two lecture theatres, class rooms fitted with appliances for teaching various branches of physics, chemistry, and mechanics, rooms for drawing, professors' rooms, workshops, an engine room, and clerks' offices. The cost of the building and fittings is estimated at £20,000 or £25,000. The funds have been provided by the City companies and the City of London, and are administered by the City and Guilds of London Institute for the Advancement of Technical Education.

The Lord Chancellor (Lord Selborne), on behalf of the Council of the City and Guilds of London Institute, welcomed his Royal Highness, and said that the institute now conducted local examinations in subjects of 32 industries, and in 85 different places. The number of candidates at the examinations three years ago was 202, last year it was 316, and this year there were 2,401 entries. Through the liberal co-operation of the Royal Commissioners of the Exhibition of 1851, a valuable site of ground at South Kensington had been given, or let at a nominal rent, to the Institute, for the purpose of erecting upon it a central institution, and sufficient funds were already provided to make it certain that it would soon be established. The object of that central institution was to give the highest kinds of instruction necessary to qualify persons to become teachers of the industrial arts and their principles all over the country. The Finsbury College was not to interfere with the necessary training of the factory and the workshop, but it was meant to give artisans that knowledge which would enable them to receive their training in the most intelligent manner. The institution had received from 28 firms connected with the business of cabinet-making and furnishing an application that their trades might be admitted to the benefits of the institution, and it was intended that they should be admitted. The institution held an intermediate place between the central institution at South Kensington and the upper schools, whether technical or middle-class schools, from which the pupils would originally come, and at the Finsbury College they would receive a sound foundation of knowledge for the practice of their different arts and trades.

Prince Leopold having guided the stone into its proper position, said, my Lord Mayor, my Lords, Ladies, and Gentlemen,—I have now had the pleasure of laying the foundation stone of the first technical college ever erected in London. The report presented by the Council of the City and Guilds of London Institute for the Advancement of Technical Education will inform those interested in this most important undertaking of the magnitude of the work, and of the energy and perseverance with which it has hitherto been pursued under somewhat adverse circumstances. The object which the institution has proposed to itself is a truly national and patriotic one. It has proclaimed its determination to enter into a generous rivalry with other countries in those branches of trade and commerce in which one must needs confess that our native industries have, of late years, not taken the position which we, as Englishmen, would wish them to occupy. The old apprenticeship system, whatever its merits may be, and whatever good work it may have

done in the past, is not equal to the exigencies of the present age, and we are beginning to realise that a thorough and liberal system of technical education must be placed within reach of the British artisan, in order to enable him to hold his own against foreign competition; and when this is done, I believe, as I have said on a former occasion, that we need not fear any rivalry in the world.

Mr. F. J. Bramwell, F.R.S., as Chairman of the Executive Committee of the Institute, proposed a vote of thanks to his Royal Highness, which was seconded by **Mr. Mundella, M.P.**, and carried unanimously.

DOMESTIC SANITATION.

At a meeting of the Ladies' Sanitary Association, held in the Rooms of the Society of Arts on Tuesday, 10th inst., H.R.H. the Princess Christian presented the prizes and certificates adjudged by Dr. B. W. Rtchardson, F.R.S., to successful candidates in the examinations on the subject of his lectures on Domestic Sanitation.

Dr. Richardson said—The presence of the Princess Christian to distribute the prizes connected with the lately delivered course of lectures to the Ladies' Sanitary Association, makes me recall an incident which, though it occurred long ago, is in some way connected with the present. In the year 1855, when sanitary science was not so popular as it is now, when, in fact, it was an ignored if not a tabooed subject, a young and enthusiastic sanitarian ventured to initiate and edit a new journal called the *Journal of Public Health*. He took great pains to get the best contributors he could, and to make the work as attractive as possible, and spent some time in inventing a motto for the title page. Many of these efforts were successful, and his motto, "*National health is national wealth*" has passed into a proverb. But in other respects his work was a failure; it got no circulation. In despair he was about to give up sanitary labours altogether, when one evening he received a short note from his good friend Sir James Clarke. Sir James in effect wrote, "I send you a hasty line to tell you something that will do you good. I had a conversation today with Prince Albert. The Prince has seen your journal, and is pleased with the tone of it. He considers your article on the sanitary condition of the army very useful, and likes your motto, 'National Health,' &c., extremely. He has directed two copies of the journal to be sent regularly to the Royal Library, and wishes you all success in your work." I can assure you, ladies and gentlemen, that no poor traveller on sandy desert ever drank from spring of fresh water more cheerfully than this sanitarian did from that intelligence, for it came to him, not only as an encouragement from the Prince Consort, but as from a pioneer in sanitary progress, who was one of the first to recognise that a truly healthy nation must be a happy, a contented, and a prosperous nation, and who had practically striven to set the foundations of that health, happiness, content, and prosperity, by showing how to lay them in good and wholesome and beautiful homes for the people. From the time he received the note of Sir James Clarke, this sanitarian never again hesitated. By lectures, by statistics, by argument, and, when the occasion offered for addressing great numbers, by allegory, he tried to teach still that "national health is national wealth." And now he has this new recognition, which will always be remembered, that after a quarter of a century, a Royal lady, who is amongst the nearest to the good and illustrious Prince, comes forward to give away the prizes, which completes his latest and, in some degree, most successful effort as a sanitary reformer. The course of lectures which has just closed is one of several courses that have been delivered before the Ladies' Sanitary Association. It was suggested to the Association by the address I had the honour to speak before Congress of the Sanitary Institute, so ably presi at Exeter by Lord Fortescue, and owing to and energy by which the movement has been by the committee, and the unceasing activi secretary, Miss Rose Adams, it has been fortunate. Nearly three hundred pupils have regular attendance, and have formed a c been, indeed, a real pleasure to instruct. The of food and digestion, of the circulation of the nutrition, of vital warmth, of breathing, and of tion, in their various adaptations to domestic have been most carefully discussed and illustra the handsome prizes offered by the distinguishe in the sanitary cause, Mr. Edwin Chadwi made the work go forward with such en that no fewer than seventy-five competito and gentlemen), with a grand total of ov hundred closely-written competitive pag entered the field in friendly contest. The papers have thus been composed on seventeen submitted for answer, and so excellent are the of the papers, so clear, so methodical, so co adjudication has almost been a penalty. T have all come to me anonymously, marked n number, so that I am ignorant at this mome the honours are awarded. I wish I could hav to everyone, for none are actually unworthy nition, while to those who are the reci merit is indeed of signal character. The "Chadwick" Prizes, a first of ten, a five guineas; a third prize of two guinea Mount-Temple; a fourth prize of one guin Marshall; a fifth of one guinea, by myself; first-class certificates of merit, sixteen first- cates of merit, and nineteen second-class ce merit. In commenting, in the briefest the results of this trial of skill, I will all to one or two of the most practical. the essays, certain candidates have ev knowledge and skill than the rest, bu shown that they have a sound knowledge c jects, viz., the relative values of the substa foods; the circulation of the blood; th breathing, with the conditions which pro and healthy dwelling; and the manageme room. On the last topic, such thoughtful c bestowed that, if I were a sick man, I d where I could look for intellectual and skil with so much hope of advantage, as a seventy-five essayists who have answered t on this all-important domestic accomplishm now, my Lord Aberdare, the time has come who give, those who receive, and those who experience equal delight. Her Royal H distribute to the successful candidates their rewards.

Mr. Chadwick, in moving a vote of tha Royal Highness, said—It is permitted me to of thanks to her Royal Highness for the h attendance here to-day, and the high sanc conferred on our proceedings. In doing to express the gratification which I feel by all, as I may presume to take it as a m of the continued interest bestowed by our E on sanitary science—the improvement of th the people. In reference to it, I had gro statement that, if all the owners of cotta Empire exercised the same sanitary care th exercised on the cottages on her Majest estates, the general sickness and death-rat reduced one-third; that is to say, it would every third year there were a jubilee, and and no deaths. At the first International when Royal Princes exhibited chiefly deco of art, the one object which her Royal fat his sole personal contribution to the Intern

, model cottage—a model of the available iples of construction. Where that model red with the sanitary principles embodied, been very extensively, the death-rates aced by more than one-third, as compared specially prevalent amongst the common he same classes of the people. Now the ounded in the able sanitary lectures which n has given, and for the proofs of which the prizes have been awarded, o principles of sanitation, food, clothing, of the house, those accessories would add gains from the improved construction of age of her Royal father, and would, I up the total gains from its use to one I, therefore, move that our cordial n to her Royal Highness for the sanction to our objects by the honour of her d the assurance it implies of the con- of herself, as a member of her illustrious rs, such as those of the Ladies' Sanitary r the prevention of suffering, and for health of the people.

was seconded by Lord Alfred S Churchill, dare (the Chairman) responded on behalf .

EAD REFORM LEAGUE.

tes, the Hon. Sec. of the Bread Reform ritten a letter to the *Miller*, in answer of Dr. Graham, noticed in this *Journal* 8), and the following extracts are here quest. In a previous letter she points out it is said that whole-meal has only 49·7 hosphoric acid, and only 3·4 per cent. of hite flour has 43 7 per cent of phosphoric per cent. of lime, as Professor Church lb. of whole-meal contains 119 grains of , whilst 1 lb. of fine white flour only con- . These per-centages show that in a le-meal there would be 59 1 grains of l, whilst in fine white flour there would The same figures show that 1 lb. of tead of containing less lime has 4·0 grains a pound of fine white flour has only 2·1 ' As Dr. Edward Smith states "That a laily from 32 to 79 grains of phosphoric ace evident what an advantage whole- fine white flour, and how essential it is ho cannot afford a plentiful supply of eggs, should be able to obtain bread this phosphoric acid, for it is a com- the blood, brain, and nerves."

have before stated, we are not relying nical analysis to prove the superior ad- heat-meal bread, but upon practical ex- benefits. Men who can easily carry from four to five hundred pounds weight be considered 'poor representatives of ' I myself have often seen this done by incipal food was wheat-meal bread, and ever touched meat, but who said they t well on white bread alone, as they felt soon after eating it."

d letter, Miss Yates quotes from Drs. , Lankester, Pavy, and Parkes, to prove is as essential as fibrine, and cannot, ny disadvantage in a bread, and that the from a dietetic point of view, most valu- r. Pavy observes, 'the power of digesting y any means such as to secure the diges- at enters the alimentary canal,' it is uppose that the cerealine (which resem- t of malt, which is now being so exten- ed) will assist the digestion of the bread. The benefit derived from food depends, not on the amount eaten, but on what is assimilated." Miss Yates concludes her reply as follows:—

"Experience shows that those nations who do not eat meat, or with whom meat is only an occasional luxury, almost invariably adopt brown bread. There are nume- rous examples of people being healthy and vigorous without ever touching meat, when their principal food is brown bread. I have already mentioned the Arab fellaheen, Turkish Hamals, and Sicilian peasants. That I have seen myself personally. From friends I hear that the Hindoos of the North-Western Provinces can walk fifty or sixty miles a day with no other food than 'chapatties' made of whole-meal with a little 'ghee' or Galam butter. The Swedish, Norwegian, and Russian peasants live principally on brown bread. The French peasantry, at the beginning of the present century, lived on brown bread, and the working classes of England have only generally adopted white bread during the last hundred years. Innumer- able examples will prove that the majority of the human race have used brown bread, and considered white bread a luxury. However much chemists may now differ, science must eventually corroborate this practical experience. Now that wheat-meal bread can be ob- tained in such a palatable and digestible form, we are certain that its general adoption would be a great benefit to both rich and poor, for they will find by experience that it sustains and nourishes them better than white bread does, and that a much larger amount of work can be done on it alone than on white bread alone.'

NOTES ON AMERICAN SCIENCE AND MECHANISM.

The Photophone.

At the meeting of the National Academy of Sciences, in Washington, U.S.A., on the 21st April, Professor Graham Bell made a communication of his most recent researches on the principles of the photophone. On his return from Europe a discovery that had been made relative to the marked results obtained when lamp-black formed an ingredient in diaphragms com- posed of silks and worsteds, led to this pigment being tried alone, with the result that when a teaspoonful of lamp-black was placed in a test tube and exposed to an intermittent beam of sunlight, the sound produced was the loudest that has yet been obtained. When a smoked piece of glass was held in the intermittent beam, the sound was loud enough to be heard in any part of the room. When the beam was thrown into a resonator, the interior of which had been smoked over a lamp, curious alternations of sound and silence were observed. The interrupting disc was set rotating at a high rate of speed, and allowed to come gradually to rest. An ex- tremely feeble musical tone, at first heard gradually, fell in pitch as the rate of interruption grew less. When the frequency of the interruption corresponded to that of the fundamental of the resonator, the sound was so loud that it could easily be heard by hundreds of people.

There seems reason to think that a practical result of the discovery here described will be the use of lamp-black in an articulating photophone, in place of the electrical receiver hitherto employed. It is now definitely established that the colour and the physical condition of the solids operated on determine the in- tensity of the sonorous effects. The explanation given by Professor Bell is to the following effect:—Lamp- black is a substance which becomes heated by exposure to rays of all refrangibility, and a mass of this substance may be looked upon as a sponge, with its pores filled with air instead of water. When a beam of sunlight falls upon this mass, the particles of lamp-black are heated, and, consequently, expand, causing a contrac- tion of the air spaces or pores among them. Under these circumstances a pulse of air should be expelled, just as water would be squeezed out from a sponge.

The force with which the air is expelled must be greatly increased by the expansion of the air itself, due to contact with the heated particles of lamp-black. The converse process takes place when the light is cut off, the particles become cool and contracted, the air space is enlarged, and, in consequence, a partial vacuum is formed, into which there is a rush of air from the outside. Owing to the great molecular disturbance that takes place in lamp-black, it is imagined that this substance will entirely supersede the costly selenium electric receiver.

Very curious results were obtained in course of experiments with the solar spectrum. Different substances—solids, liquids, and gases—were used as receivers, disclosing the fact that the maximum of sound produced with them varied in point of position on the spectrum in a remarkable manner. With the lamp-black receiver a continuous increase in the loudness of the sound was observed upon moving the receiver gradually from the violet into the ultra red, far out into which the point of maximum sound lay. Beyond this point a slight motion of the receiver caused complete silence, so abrupt was the passage from the maximum sound into its absence. These experiments have led to the construction of a new instrument for use in spectrum analysis. The eye-piece of a spectroscope is removed, and sensitive substances are placed in the focal point of the instrument, behind an opaque diaphragm containing a slit. Those substances are put in communication with the ear by means of a hearing tube, and thus the instrument is converted into a "spectrophone." While it is not claimed that the ear can, for a moment, compete with the eye in the examination of the visible part of the spectrum, in the invisible part beyond the red, where the eye is useless, the ear will be invaluable; and for this reason the "spectrophone" must ever remain an adjunct to the spectroscope, in addition to its having a wide and independent field of usefulness in the investigation of absorption spectra in the ultra red.

THE KEELEY MOTOR.

There are few at the present time acquainted with the higher walks of mechanism who have not heard of the "Keeley Motor." Now, what this "motor" is, no person seems to know; what it proposes to do after it has once been brought to a state of completion is really invaluable, *inter alia*, from the charming simplicity with which its claims are put forth, viz., to get an enormous amount of mechanical power from nothing, or at any rate from nothing at all worth speaking of; for instance, a glassful of water to drive a railway train for over a hundred miles. Keeley was confident of his being able to solve the problem, and the stock-holders and stock-dealers equally confident that there was something in it. It is true that it has long been the standing ridicule of mechanics of the every-day school, and for several years reputable journals such as the *Scientific American* have always linked the word "deception" to the usual title of the inchoate power; but what more easy than to persuade moneyed speculators that all great and new discoveries are subject to detraction? Accordingly money has flowed in plentifully, until recently when stock holders began to demand that they must see something, plenty of time having surely elapsed since first the stock was thrown into the market. But as Mr. Keeley retained the "secret" in his own hands, he was master of the situation, and if they would not advance more money it would be their own loss, as his invention was now almost perfected. A "first public exhibition" of the Keeley engine was, however, determined upon, and was given in Philadelphia on the evening of the 22nd April, in presence of a large body of New York men, among whom are some of fairly high social and political standing, but none whose names are recognised as belonging to the world of practical machines. When the visitors were seated, they saw before them a well-polished steel machine composed of tubes and globes. Like a scene connected with conjuring apparatus, the first act consisted in r
every cock and tube, ostensibly to show t
apparatus was empty. Lights were placed und
and the visitors were invited to look into and
the various chambers. The performance th
menced by one of the company pouring a glass
into half-a-dozen funnel-topped tubes, and in
twenty-nine seconds after the last drop went in
sure was generated sufficient to raise a six-fo
(one inch fulcrum), upon which were hung 700
weight. The pressure was asserted to be 15,000 p
the square inch. Pausing for a moment, I may
that innumerable Englishmen, and also m
Americans, are aware that a "Geyser" apparatu
has for years, been in London an article of comm
means of which cold water poured into a rese
the top emerges, after a few seconds, from a f
the bottom, heated to the boiling point. But
Mr. Keeley's visitors on the occasion referred t
not quite aware of what takes place when a d
water is allowed to come into contact with
metallic surface. The vapour said to create the
sure, in the experiment now being described, wa
passed into a steel cylinder about 30 inches lon
inches in diameter, through the centre of whi
stretched an ordinary piece of piano wire, a
means of some mysterious influence exerted by
of mammoth "tuning fork," was said to be "vi
by its vibrations. This vapour was then conv
the engine in another room, to which all the
were then invited to move. Here was pl
engine, or piece of mechanism, that at present
considered as indescribable. After the opening
cocks, something, that was termed a "spiro
contained in one of the cylinders, or rather d
the mechanism began to roar, and a shaft c
with it began to revolve rapidly. The rapidit
revolutions of the engine were controlled by Mr
striking an iron disc or drawing a bow over
stretched steel wire. Now, what does all th
piece of mechanical legerdemain amount to? wi
inquiry of the sober, common-sense mechan
writer has sought to obtain at head-quarters
York some reliable information concerning this
"new power," which he could place before th
of the *Journal of the Society of Arts*, but has qu
up to the present time in being able to acc
position of reliability or genuineness, notwith
that Commander Gorringe and others speak
they saw as perfectly wonderful.

NEW AMMONIA ENGINE.

Different altogether from the "motor" jus
of is a "low temperature motor," into which
what searching examination has just been mad
chief engineer of the Navy Department of th
States of America. This differs *ab initio* f
"Keeley Motor," in that there is no alleged
everything being explainable on scientific p
Originating in a machine in which ammonia
as a means of producing ice, experiments ha
the discovery of a motor which, when complet
it is stated, prove of inestimable value.
being converted into gas under high pressure
nary temperature has about three times the
force of steam. While water requires to be
to a high degree of heat ere its powers can be p
ammonia, on the contrary, puts forth its pow
ordinary temperature. The difficulty herto
been to get the ammoniacal gas condensed
has operated on the end of a piston. It is now
by Chief Engineer Isherwood, who is acting
matter with Professor John Gamgee, that this
has been overcome. In the new ammonia engi
is a high pressure boiler where the ammonia is c
into gas by the heat in water of ordinary atm
temperature, and a low-pressure boiler, in

is kept at a considerably less tension than in ;, and with which the engine is operated. ng its work, the cooled and shrunken gas and e discharged by an ejector worked by the essure in the high-pressure boiler. This excess nia in the liquid form is pumped from the low-back to the high-pressure boiler, while the heat is continually being converted into the al work done by the engine. The high of the men engaged in working out this idea, open manner in which they state the whole s upon which every action is based, proves to ent a guarantee of the possibility of something being eventually achieved by its agency, for, e "Keeley Motor," there is in the ammonia secrecy as regards either principle or mode of

k, April 26th, 1881.

METEOROLOGICAL SOCIETIES.

ubject of Mr. G. J. Symons's presidential at the last annual general meeting of the logical Society, was "The History of Meteorological Societies—1823 to 1880." The English effort at forming a meteorological r, at any rate, at securing observations made parable instruments, recorded upon a uniform was made in 1723 by Dr. James Jurin, who a secretary to the Royal Society. In the phical Transactions" for that year will be able Latin address by Dr. Jurin, in which he es nearly all the conditions which we now con-ential for comparable observations. This appeal lead to much being done, and 20 years later, 3rd, 1744, another attempt was made by Mr. ickering, F.R.S., who read before the Royal a paper, entitled "Scheme of a Diary of the ;, together with Draughts and Descriptions of s subservient thereunto." The Royal Society egin their register until 1774, and then they only d it consecutively until 1781, after which they several years to elapse before they again under- In 1780, the Meteorological Society of the te was formed, and in the following year they ced their observations. The secretary of this im Society died in 1790, and from that time ety languished, and finally became extinct he troubles and wars of the French Revolution. t meeting for the formation of the Meteoro-ociety of London was held on October 15th, the London Coffee-house, Ludgate-hill, Luke , Thomas Forster, Dr. Clutterbuck, J. G. &c., being among its chief supporters. The anguished soon after its foundation, but was in 1836, and finally died about 1843. Seven terwards the British Meteorological Society ded by Dr. Lee, Admiral Smythe, and many pporters of the old society. In 1866, the society a Royal Charter of Incorporation, and, ceasing he BRITISH *Meteorological Society*, became THE logical Society."

GENERAL NOTES.

Engine.—The following description of a solar given by Mr. G. F. Rodwell, in his report of the the French Association for the Advancement of t Algiers, in *Nature*:—"In the Agricultural Exhi- of the most interesting machines is the solar engine, of which is placed in the axis of a mirror 14 feet er, and formed of three portions of hollow truncated as to get a close approximation to the parabola. e sun shines a pressure of from three to four atmospheres is produced in the boiler, and a force of one-horse power is produced through the intervention of an ordinary steam-engine. The mirror is of silvered copper; the boiler is blackened and is surrounded by a glass cylinder, which of course permits the passage of the sun's heat through it, but obstructs its escape after absorption. The whole thing costs 4,000 francs, and it could be used in many countries for at least 200 days in the year.

Fruits from the West Indies.—The success which has attended the experimental shipments of ripe fresh fruits from Australia has set the West Indians on their mettle, and several planters have turned their attention to the cultivation of oranges, pine-apples, bananas, and other fruits, especially for shipment to Europe. America has hitherto been the chief customer of the West Indian Islands for fresh fruits, but there is no reason why England should not share in the fruit produce of her nearest tropical colonies. At the present time the trade in pine-apples is pretty well monopolised by the Bahamas, from whence we receive the cheap fruits which are displayed in a more or less damaged condition on the costermongers' barrows in the streets of London during the summer months. But if more care were taken in selecting and packing the fruit, pine-apples might be received in excellent condition from all the West Indian Islands, and not only pine-apples, but bananas and oranges. The greater expense which would be incurred by a little more care in packing the fruit, and the additional cost of freight, would be more than covered by the higher prices which would be realised for ripe oranges, for instance, which could be sold at the time when such a luscious fruit would be most highly appreciated, viz., during the summer months, and at a time when the ordinary supply of European oranges would not be in the market. One enterprising cultivator in Jamaica, who has lately taken to growing pine-apples for export, has realised as much as £80 per acre. The trade in bananas is also increasing, at least, so far as Jamaica is concerned, and last year nearly half a million bunches were exported from that island, valued at over £38,000. In the case of oranges the value exported last year from Jamaica was over £11,000.—*Colonies and India.*

Gum Arabic at Trieste.—Mr. L. Ordega, Consul-General of France at Trieste, has furnished, under date of August 10, 1880, some statistics relating to the amount of gum arabic which arives at Trieste from Africa. The total importation and exportation during the years 1877, 1878, and 1879, was as follows:—

	Importation.	Exportation.
1877	2,695,100 kilos.	2,707,600 kilos.
1878	2,726,300 ,,	2,796,400 ,,
1879	4,638,400 ,,	3,080,900 ,,

The gums are divided into thirty-two grades, the prices of which vary from about 75 dollars for the best, to as low as 13 dollars per 100 kilos. for the commonest kinds. The available stocks during 1877 amounted to 1,700,000 kilos., but, in 1879, they exceeded 3,600,000 kilos, and even this enormous reserve was hardly sufficient to satisfy the demands from the various markets of Europe. On August 1, 1880, the stock on hand at Trieste was as follows:—

	Kilos.
Arabic	387,000
Ghizira	57,000
Sennary	1,400
Suakin	313,600
Gedda	79,000
Total	838,000

The construction of new routes has rendered the transport of the Suakin gum more easily from its place of origin to the port of debarkation. Owing to the interruption of communication caused by certain rains called "karif" in Egypt, no arrivals whatever from Suakin reached Trieste during the whole of last October.

Fruit Gardens of Bohemia.—The number of fruit trees in Bohemia of all sorts, but chiefly apples, appears, from some recently published statistics, to amount to 14,000,000. Of these, 10,000,000 are in gardens, 1,600,000 in waste lands, and about 2,000,000 on the sides of the public roads. The number of young trees annually planted is about 1,500,000. Between 6,000 and 7,000 miles of road are planted with fruit trees, mostly of the best sorts, and the revenue therefrom is very large. The fruit is largely exported to the north of Germany and Russia.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock:—

MAY 18.—"The Electrical Railway, and the Transmission of Power by Electricity." By ALEXANDER SIEMENS. Dr. SIEMENS, F.R.S., will preside.

FOREIGN AND COLONIAL SECTION.

Tuesday evenings, at eight o'clock:—

MAY 31.—"The Principality of Loo Choo." By Consul JOHN A. GUBBINS.

APPLIED CHEMISTRY AND PHYSICS SECTION.

Thursday evenings, at eight o'clock:—

MAY 26.—"Telegraphic Photography." By SHELFORD BIDWELL. Prof. W. G. ADAMS, F.R.S., will preside.

INDIAN SECTION.

Friday evenings, at eight o'clock:—

MAY 13.—"Burmah." By General Sir ARTHUR PHAYRE, G.C.M.G., K.C.S.I., C.B. Sir RUTHERFORD ALCOCK, K.C.B., will preside.

Members are requested to notice that it may be necessary to make alterations in the dates of the above papers.

CANTOR LECTURES.

Monday evenings, at eight o'clock:—

The Fifth Course will be on "Colour Blindness and its Influence upon Various Industries," by R. BRUDENELL CARTER, F.R.C.S. Three Lectures.

Syllabus of the Course.

LECTURE I.—MONDAY, MAY 16.

Introductory. Nature of colour vision generally. Solar light—its composition. The prismatic spectrum. Invisibility of certain elements of the spectrum to the colour-blind. Appearance of the combinations of the remaining elements. Varieties and definitions of the resulting colour blindness.

LECTURE II.—MONDAY, MAY 23.

Mistakes of the colour-blind in daily life. Their methods of endeavouring to counteract the consequences of their defect. Modes of testing for colour blindness. Sources of error in testing. The actual prevalence of the affection in this and other countries, and in different classes of the population.

LECTURE III.—MONDAY, MAY 30.

Industries chiefly affected by colour blindness—Engine-drivers, pilots, artists, letter-sorters, drapers, painters, &c., &c. Recent legislation affecting colour blindness in America, and urgent need for it in this country. Conclusion.

ADMISSION TO MEETINGS.

Members have the right of attending all the Society's meetings and lectures. Every Member can admit *two* friends to the Ordinary and Sectional Meetings, and *one* friend to the Cantor Lectures. Books of tickets for the purpose have been issued to the Members, but admission can also be obtained on the personal introduction of a Member.

MEETINGS FOR THE ENSUING WE

MONDAY, MAY 16TH...SOCIETY OF ARTS, Adelphi, W.C., 8 p.m. (Cantor Lectu Brudenell Carter, "Colour Blindness, and upon Various Industries." (Lecture I.)
Institute of Surveyors, 12, Great George- 8 p.m. Resumed Discussion on Mr. Paper, "Land Law Reform."
Victoria Institute, 7, Adelphi-terrace, W.C Joseph Fayrer, "The Rainfall of India."
Social Science Association and Law Amend 1, Adam-street, Adelphi, W.C., 8 p.m. "A Consolidation of the Acts relating to and Industrial Schools."

TUESDAY, MAY 17TH...National Health Society (a OF THE SOCIETY OF ARTS), 7½ p.m. M Hellyer, "The Science and Art of Sanitary (Lecture I.)
Royal Institution, Albemarle-street, W., Dewar, "The Non-Metallic Elements."
Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on Mr. John I. Paper, "Torpedo Boats and Light Yach Speed Steam Navigation."
Statistical, Somerset-house-terrace, Strand,
Pathological, 53, Berners-street, Oxford 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m

WEDNESDAY, MAY 18TH...SOCIETY OF ARTS, Adelphi, W.C., 8 p.m. Mr. Alexander S Electrical Railway, and the Transmission Electricity."
Meteorological, 25, Great George-street, S. Mr. Richard H. Curtis, "Comparison of Osler's Anemometers, with Remarks on in General." 2. The Hon. F. A. Rollo R on Waterspouts observed at Cannes i February, 1872." 3. Mr. Alexander Be Swedish Meteorological Observations in c the Return of the Seasons."
Pharmaceutical, 17, Bloomsbury-square, Annual Meeting.
Archæological Association, 32, Sackvill 8 p.m. Dr. Phené, "Oak Figures Discov Brittany, &c."
Sanitary Institute of Great Britain, 9, Cond 8 p.m. Adjourned Discussion on the Richardson, "Suggestions for the Manag of Small-pox and of other Infectious Metropolis and Large Towns."

THURSDAY, MAY 19TH...Bankers' Institute (in the London Institution, Finsbury-circus, 1. Sir Richard Temple, "The General Mo amongst the Natives of India, with so the use and probable future absorptio Coin; and an account of such practice Natives as have a Banking character, and larger Banking operations of the Country General Meeting.
Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m
Chemical, Burlington-house, W., 8 p.m. 1 Wright, "The Re-action between Hydro Oxide in the presence of Spongy Platinum V. Pisani, "A Method for the Ready E Soluble Sulphide and Free Sulphurous, phuric Acid, even in the Presence of Sulp
Society for the Encouragement of Fine Ar street, W., 8 p.m. Mr. Frank Rolan Decoration of Auditoria."
Royal Institution, Albemarle-street, W., Tyndall, "Paramagnetism and Diamagne ture IV.)
Royal Historical, 22, Albemarle-street, W.,
Numismatic, 4, St. Martin's-place, W., 7 p.
Philosophical Club, Willis's-rooms, St. J 6½ p.m.

FRIDAY, MAY 20TH....Royal United Service Institut yard, 3 p.m. Vice-Admiral G. G. Ra Relative Values of the Group of Three a Unit for Naval Tactics."
Royal Institution, Albemarle-street, W., 8 Meeting. 9 p.m. Mr. W. H. Pollock, " Criticism."
Philological, University College, W.C., 8 versary. Annual Address by the Preside
National Health Society, 23, Hertford-stre (Drawing-room Lectures.) Dr. Siemens, Grates."

SATURDAY, MAY 21ST....Royal Institution, Albemar 3 p.m. Prof. C. E. Turner, "Russian (Lecture I.) Pouschkin.

OF THE SOCIETY OF ARTS.

No. 1,487. VOL. XXIX.

[F]RIDAY, MAY 20, 1881.

[All communications] for the Society should be addressed to the Secretary [John]-street, Adelphi, London, W.C.

NOTICES.

CONVERSAZIONE.

[The Society']s *Conversazione* is fixed to take place [at the South] Kensington Museum (by permission [of the Lords] of the Committee of Council on [Education]) on Thursday, June 2nd. The cards of [invitation are] now in course of issue.

CANTOR LECTURES.

[The fifth] lecture of the fifth Course, on [Deafness] and its Influence upon Various [Sciences,] was delivered by R. BRUDENELL [CARTER, F.R]C.S., on Monday, 16th inst.

[The lectur]es will be printed in the *Journal* [during the a]utumn recess.

FURNITURE EXHIBITION.

[The Exhibi]tion of Works of Art applied to Furni[ture, in conne]ction with the Exhibition of Fine Arts [at the R. A]lbert Hall, will be opened to-morrow [(Saturday).] The following are the exhibitors:— [...a]d Son; Morant, Boyd and Blandford; [...G]raham; Gillow and Co.; Holland and [...; Howa]rd and Sons; Wright and Mansfield; [...] Lock; Gregory and Co.; Shoolbred [...; Joh]nstone, Jeans and Co.; Sidney Phelps; [...]s; and the National School of Wood [Carving. A] non-transferable season ticket for the [Exhibition w]ill be sent to any Member of the [Society who m]ay apply for one to the Secretary.

[E]XAMINATION IN VOCAL OR INSTRUMENTAL MUSIC.

[The E]xamination in London will be held [by Mr. Hull]ah, the Society's Examiner, at the [House of th]e Society of Arts, 18, John-street, [Adelphi, W.C]., during the week commencing on [...] 1881.

[Particu]lars can be obtained on application [to the Secret]ary.

PROCEEDINGS OF THE SOCIETY.

APPLIED CHEMISTRY AND PHYSICS SECTION.

Thursday, May 12, 1881; Professor F. A. ABEL, F.R.S., Vice-President of the Society, in the chair.

The paper read was on—

RECENT PROGRESS IN THE MANUFACTURE AND APPLICATIONS OF STEEL.

By Professor A. K. Huntington,
King's College, London.

At first sight, the title which I have given the paper I am about to bring before you this evening, might lead some to suppose that it was intended to deal with very recent events, such as might have occurred within the last few months, or say a year. Such anticipations would be fully justified were I to address you on recent progress in the applications of electricity, for this offspring of intellects of our own era makes marvellous progress from day to day, until one feels tempted to concede to it a position in the universe similar to that occupied in the human body by nerve force. In fact, the want of continuity between our nerve system and what we may call that of the world is fast becoming less and less. We can already flash our ideas and our voices to the farthest parts of the earth, and the reproduction of the images of material objects by similar means seems to be in a fair way of accomplishment. But the subject of our attention to-night had its commencement in times so remote as to be far beyond the reach of human record, and its rate of progress may be measured by that of the world itself in the Arts and Sciences.

Improvements in the Arts and Sciences have gradually modified the methods of producing iron and steel; and, in their turn, the Arts and Sciences have felt the re-action; for all improvements in the manufacture of iron and steel have been not so much in the production of a better quality of article, but in the cheapening of production, by the application of the principles indicated by the progress of science, and by the use of superior machinery. The direct result of this cheapening has been to extend the applications of the products in the Arts. To appreciate this, let us glance back, and see by what means steel was produced up to the year 1855, and what were its applications, and then trace out the causes of the changes which have since taken place in these respects.

The discovery of steel appears to have naturally followed that of the means of reducing iron from its ore. In all primitive methods of iron smelting, steel, in more or less quantity, is inevitably produced. Such methods have been carried on in India and Africa from time immemorial to the present day. A similar furnace has, for several centuries, been employed in Catalonia, in Spain. The comparative cheapness of iron manufactured in other countries by improved methods, is, however, rapidly causing this furnace to pass out of use.

I propose now briefly to describe to you the process in the Catalan furnace, as it is called, in the form

into which it last developed in Spain and the South of France, in order that we may clearly understand the essential differences between iron and steel, both as regards their composition and properties, and also the conditions requisite in the production of each.

Mode of Conducting the Process.—The ore is crushed by the hammer, and divided by sifting into lumps ("mine") and very coarse powder ("greillade"). The furnace being still red-hot from the last operation, it is filled with charcoal nearly to the twyer, the hearth is then divided at a point about two-thirds distance from the twyer into two parts by a broad shovel; on the blast side a further quantity of charcoal is added, whilst that on the other side having been rammed down firm, ore is added, so as to fill that part of the furnace; on this is placed moistened charcoal dust, except at the top. A good blast is then turned on, and if the whole is in good order, jets of blue flame at once issue from the uncovered portion of the ore. After a few minutes the pressure of the blast is lowered to 1·5 in. of mercury. At intervals during the process—which lasts about six hours—the blast is gradually raised until it reaches about 3 in., the maximum usually employed.

During the whole of the process, at short intervals, "greillade" and charcoal are added, and well moistened with water, to prevent too rapid combustion. After about two hours from the commencement, the wall of "mine," *i.e.*, ore in lumps, is pushed well forward under the twyer, and more "mine" is thrown into the space thus made; this part of the process is also subsequently repeated at intervals, until sufficient has been added to form a lump of iron or *massé* of the required size. From time to time slag is removed by opening the tap-hole. At the completion of the process, a mass of metal is obtained weighing about 3 cwt., which invariably consists partly of soft iron, and partly of steely iron and steel.

Reactions in the Furnace.—We have seen that in the one part of the furnace only charcoal and "greillade" are introduced, and in the other only lumps of ore. That the ore should be in lumps at that part is a very important point, for in this way the hot reducing gas, carbonic oxide (CO), generated by the action of the blast on the charcoal, is able to pass freely through the mass of the ore, the effect of which is that the water of hydration and the moisture are first driven out by the heat, and then the ore having become easily permeable, the carbonic oxide reduces it to metallic iron, thus, $Fe_2O_3 + 3CO = Fe_2 + 3CO_2$. There are, however, several stages in this reduction, magnetic oxide being first formed thus, $3Fe_2O_3 + CO = 2Fe_3O_4 + CO_2$; and protoxide is next formed before metallic iron is obtained thus, $2Fe_3O_4 + 2CO = 6FeO + 2CO_2$, and $6FeO + 6CO = 3Fe_2 + 6CO_2$. At the same time that these reactions are going on, the ore has become impregnated with carbon, derived from the decomposition of the gases with which it is charged. That this would be the case, the experiments of Mr. Lowthian Bell and others can leave no manner of doubt.

On the twyer side, where are placed the charcoal and "greillade," the latter, as the charcoal is burnt away, descends rapidly, and, to a considerable extent, doubtless, escapes reduction, for the arrangement of the blast is such that most of the reducing gas is projected on to the lumps and does not pass up through that portion furnace occupied by the charcoal and "gre which, besides, are constantly damped "greillade" is much richer in silica larger pieces, from which it results quantity of slag will vary with the "gr added. It is always very rich in oxide of

Now, what happens in this process be this: carburised iron is produced gradual reduction and fusion of the lum and this, coming in contact at the botto furnace with slag, very rich in oxide of carbon of the one combines with the oxyg other, and the result is that iron containing or less carbon is produced, according as mu little oxide was present.

The obvious conclusion would be, that the le there was of "greillade" present the more ste would be the iron; in practice this is found to the case. This circumstance would natur suggest the total suppression of the "greill when it was desired to produce steel. This wo however, be impracticable, for it is necessary some of the oxide of iron should remain unredu in order to flux off the silica, which occurs in c siderable quantity in the ore. In the furnace, this difficulty is got over by emplo lime; but lime at the temperature of the Cat furnace would not produce a sufficiently li slag.

All that can be done, then, is to employ available means to prevent decarburisation. cordingly we find that when steel is require addition to using less "greillade," the sl tapped out more frequently, so that the lu iron, as it forms, may remain as little tin possible in contact with it. The bank of exposed for a longer time to the reducing carburising gases, and is pushed more towards the twyer, so as not to become d burised by the air which has not had tin combine with the carbon of the charcoal. L manganese should be present. It is found the presence of manganese has a very impo influence, which is probably due to its pow replace iron in the slag. A slag conta manganese is more liquid than if it containe alone, and, according to François, has not the tendency to cause decarburisation at the tem ture of this process.

In order, then, that steel may be produced b process, every precaution is taken to cause as carburisation as possible; the unavoidable pre of oxide of iron in the slag, and the low tem ture, effectually preventing the formation of iron; the former, indeed, making it very dif as we have seen, to obtain steel.

It might be said, why not increase the tem ture, so as to obtain a liquid slag without oxide of iron. If the temperature were incre cast iron, instead of steel, would be produced fact, that is exactly how cast iron first came obtained in blast furnaces.

I have gone rather fully into this process cause the principle of it is not always well u stood. Rightly looked at, it explains how was first obtained, and what the essential condi are, in the production of steel. When, to the increased size of blast furnaces, and

ıcrease in temperature, cast iron be- y product, it naturally followed that ı should be treated with a view to the steel. This was first effected in the and formed an important industry inthia, the Tyrol, and other places, ıich it is still carried on.

on was conducted in a finery, similar n to those employed in the production ct, iron and steel are often produced the same finery. This furnace, in ırm, consists essentially of a shallow hearth, formed of cast-iron plates. a twyer, inclined at an angle of 10° bottom is kept covered with a layer

egen district, a piece of pig iron, bs. to 60 lbs., is placed on the hearth, ›reviously heated; the hearth is then lled with burning charcoal; on it is ion of the cake produced in the last l which has been kept hot in burning the back of the furnace. The re- ıe hearth is then filled up with char- :her six or seven pieces into which was divided, are placed on the top. ss the production of steel, and the that obtained in the last operation, o working it under the hammer, are gether. The blast is turned on. The ron forms into a pasty mass; cinder, of iron, produced during the latter preceding operation, is then thrown piece of pig-iron, weighing about dded, and, afterwards, four or five geleisen, weighing each about 100 lbs., ly added. (Spiegeleisen is cast iron, anganese, in this case about 4 per cent.) s found to be too much decarburised, l is added. The cinder is usually ıe 2 inches or 3 inches above the cake r excess being tapped off. There are fications of this process, but I have to make the principle clear. In this the Catalan, it is impossible to obtain us product. The principle in both is ıe same, viz., decarburisation by oxide the finery process, in addition to the in the form of cinder and scale pro- ; the working of the metal under the ne results from the reheating, which is carried on at the same time. In manganese also plays an important shall see that in every process for the f steel, manganese is used with great

notable exception—the cementation early methods for the production of imply modifications of the methods g malleable iron. Accordingly, we introduction of the puddling process, ıalleable iron is produced in a re- urnace, was soon followed by a similar ıe manufacture of steel.

ial difference between the finery and g process consists in the use of a r furnace, the manipulation of the he regulation of the temperature y greatly facilitated. The decarburi- ted by the addition of oxide of iron produced during rolling, and partially by the air which enters the furnace as the metal melts slowly down; manganese is added during the process. It is important that the temperature should be kept low. It is difficult to weld this steel perfectly; this is probably due to the temperature at which the steel has to be worked being too low to make the cinder sufficiently liquid to enable it to be squeezed out under the hammer to the same extent that it is in the case of malleable iron. This difficulty has, however, been got over by completely fusing the steel before working it, so as to enable the slag to completely separate. In this form metal manufactured by this process has been largely used by Krupp. This defect is common to all steel which has been produced without fusion.

The same principle as that which regulates the production of steel by the foregoing methods is taken advantage of in the Uchatius process, which was patented in 1855.

Pig iron is first granulated by running it while molten into cold water. The granulated metal is then mixed with about 20 per cent. of roasted spathic ore, crushed fine; the mixture, to which a little flux has been added, if necessary, is then fused in clay crucibles. If very soft steel is required, some wrought-iron scrap is added.

Lastly, in this category we have a process which consists in heating cast iron, but not so as to soften it, in oxide of iron, in the form of ore or iron scale. In this way partial, or even total, decarburisation of the metal can be produced at will.

So far we have seen, then, that the difference between iron and steel is merely one of degree depending on the amount of carburisation. The methods we have considered, in fact, are only modifications of those practised for the production of malleable iron.

We will now pass to the brief consideration of the different methods of procedure for the production of steel, which, however, I think I shall be able to show naturally resulted from the observation of phenomena occurring in the first process we have had under consideration.

These processes have for their object to impart a certain amount of carbon to malleable iron. The Hindoos have practised one of them from time immemorial. They place in unbaked clay crucibles of the capacity of a pint, a piece of malleable iron, and some chopped wood, and a few leaves of certain plants; the top of the crucible is then closed with clay, and the whole well dried near a fire. A number of these crucibles are then strongly heated for about four hours in a cavity in the ground, by means of charcoal and a blast of air forced in by bellows. There is some reason to believe that an excess of carbon, over that required to produce the hardest steel, has to be added, in order to fuse the metal at the temperature which can be commanded in these furnaces. Before being drawn out into bars, the cakes of metal obtained in this way are exposed in a charcoal fire during several hours, to a temperature a little below their melting point, the blast of air playing upon them during the time. The object of this is, doubtless, to remove the excess of carbon.

In 1800 a patent was taken out by David Mushet, for a process in every respect analogous to that just referred to. He appears, however, to

have applied it to the manufacture of a metal low in carbon, and therefore intermediate between iron and steel, partaking in a certain degree of the properties of both, corresponding, in fact, to what we have referred to as steely iron. Since this metal must have been in a state of fusion, Mushet must have brought to bear upon it a very high temperature. The manufacture was conducted in crucibles.

In another method referred to by Biringuccio, in 1540, steel is produced by keeping malleable iron in molten cast iron until it became pasty, and on examination was found to possess the properties of steel. In connection with the theory of steel manufacture this process is of great interest. It shows that iron in a strongly-heated condition is capable of absorbing carbon by direct contact, unless we suppose that the carburisation is effected by dissolved gases, which is possible, for Graham and others have proved that iron can occlude gases even when it is in a solid state.

If we admit that the mutual affinity of carbon and iron, is such as to cause them to unite at the temperature of molten cast iron, it is then not difficult to conceive how the whole mass becomes carburised without the intervention of occluded gas. In asking you to concede that the surface of the iron enters into combination with the carbon in this way, I am strictly within fact, as shown by the Hindoo and Mushet processes. A marked case of this kind occurs when sulphur and silver or copper are brought together at the ordinary temperature, combination takes place.

The particles of iron at the surface having taken up carbon, their affinity would be satisfied, but the affinity of the atoms contiguous and beneath would at once come into play, and would only be satisfied by an equal division of the carbon between themselves and those on the surface.

Imagine a man carrying four cannon balls, his strength just sufficing for the task; he encounters an enemy equally strong, but who is unencumbered, and, therefore, in the possession of his whole strength.

For the sake of simplicity, we will call the man carrying the cannon balls A, and the other B. B first applies his whole strength to wrest one ball from A, and succeeds, for the chances are 4 to 1 in his favour, A holding the ball only with a fourth-part of his strength, whereas B applies the whole of his. B then tries to obtain another ball from A, and again succeeds, for the force he applies in relation to the resistance offered by A, is as 3 to 2. A and B are now on an equal footing; each is capable of taking up two more cannon balls, should the opportunity present itself.

Now, let the cannon balls be represented by the carbon atoms, and A and B by the surface and the inner contiguous particles of iron, then the bath of molten cast iron will form a reservoir from which A can re-charge itself. In the mean time other particles, C, will have deprived B of part of its carbon, just as B did A, and B will, therefore, be again in a position to obtain carbon from A.

The same reasoning would apply to each successive layer of metal throughout the mass, that on the surface taking up carbon continuously from the bath of molten metal, until, if the process were continued long enough, the malleable iron would become converted into cast iron of the same composition as that in the bath into which would dissolve.

We now come to what is called the cem process. It is not known when this pr first used. It was well described by Ré 1722. In this method bars of iron are glowing red heat, surrounded with ch boxes, into which the air is prevented fro ing. The operation lasts from seven to according to the quality of steel require bars are never uniformly carburised, and they contain cinder, as the metal has ne fused. The process had been a long tim however, before it occurred to any one to steel and make it homogeneous. This wa Huntsman, about 1760. It was the first steel had ever been intentionally obtai molten state, unless we except the Hindoo but the fused product in that case was too highly carburised to constitute steel. already premised that the addition of c malleable iron, in order to produce steel, from the observation of what took plac processes first described. It was, in fact, of common observation that iron, no whether solid or molten, kept in cont carbon, became more or less steely. Wh natural then than to endeavour to produ directly in this way?

By all the processes we have so far re good steel could be produced, but only i quantity and at great expense. The appl of steel were, in consequence, very limited; practically, its use was confined to impleme a cutting edge.

In 1845, Heath patented a process whi it been successful, would have given him th of producing steel in quantity. He prop melt scrap iron in a bath of molten pig ir reverberatory furnace heated by jets of gas. were two conditions wanting in this which caused it to be a failure, viz., a suf high temperature and the power to easily the character of the gases employed. Ne less, in this suggestion is to be found the one of the two most important processe present day. By the foregoing remarks I intend to imply that the idea of mixing and cast iron together to produce steel wa nated by Heath. On the contrary, as we expect, this idea was a very old one. I Réaumur tells us that he succeeded in maki steel in a common forge in this way. As f aware, however, Heath was the first to sug use of a reverberatory furnace and gas purpose, and that is the important point.

It may here be pointed out, that the facture of steel by this method does not de any means entirely on the adjustment of t tive proportions of wrought iron and pig i appears sometimes to be thought by th specially acquainted with the process. a good deal of oxidation going on dur operation, which results in the eliminatio equivalent proportion of carbon from the p

The dominant idea in treating cast iron had always been to refine the metal by th of atmospheric air, and this was effected by a current of air to impinge upon the surfac metal, by means either of blowing appa

lrawing action of a chimney stack. What more ral than that it should occur to someone to e iron by blowing air into it, instead of merely o its surface? We find that this idea did ally occur to several persons, widely separated, e year 1855. It is a noteworthy fact that a large number of what we call discoveries or ations are made simultaneously and indepen- ly in different parts of the world by people who iously had probably never heard of one another. would seem as if the records of observations mulated in men's minds, and in books, until naturally pointed to certain conclusions. man who follows up these conclusions, and ies them in practice, is not always the one who perceived them. To carry out what appears e world at large as new ideas, requires great ngth of purpose, and such a combination of mstances as to afford an opportunity.

a this year (1855), a patent was taken out by n Gilbert Martien, for refining iron, by forcing through it as it flowed from the blast furnace apola, along runners, to the puddling furnace. s conception was a very important one in the e that had not others been working in tly the same direction the same time, it ld probably have assisted in working out the blem involved. The process, as detailed in the nt, was impracticable, and shows internal ence of not having been worked out on a manu- ring scale.

st after this patent was taken out, we find rge Parry, of the Ebbw Vale Works, making experiment of forcing air through molten iron, on the bed of a reverberatory furnace, neans of perforated pipes imbedded in the fire- bottom. Vigorous action is stated to have n place, but, unfortunately for the experi- tors, the metal, through an accident, escaped a the furnace, and the further trial of the pro- was discouraged by the managing director. re can be no manner of doubt that had this riment been continued, very important results ld have ensued. As the Ebbw Vale Company bought Martien's patent rights, it would ear that their experiments were really based on dea. Of this I am not, however, certain, as I not aware of the date at which they made the hase.

wo or three months after these experiments, ry Bessemer took out his now celebrated nt for the production of cast steel, by blowing through molten cast iron; it should be clearly e in mind that he had been, for a considerable e, previously engaged on experiments on the ect.

Whether Bessemer originally started with the of refining pig ready for puddling, and, in the se of his experiments, made the discovery that the action of the oxygen of the air on the carbon he pig iron, such an enormous heat was pro- ed that the resultant iron was obtained in a ten state—a thing never before accomplished— not know. The only alternative is that he ved at the same conclusion, by inductive oning, which, all things considered, is very robable.

essemer first carried out his process in crucibles, ed in furnaces and arranged so that the con- s could be tapped from the bottom into moulds. Steam or air, either separately or together, and by preference raised to a high temperature, was forced down into the crucible through a pipe. The patent goes on to state that steam cools the metal, but air causes a rapid increase in its temperature, and it passes from a red to an intense white heat.

It was, and still is, to a less extent, an infatuation of patentees, to employ steam in the place of air. Bessemer soon discovered the essential difference which exists in practice though not realised by the excited imaginations of the majority of would-be inventors. Bessemer at first used extraneous heat to start the process, if not, indeed, during its progress, which shows that he was not then aware that the heat created by merely blowing in air would be sufficient.

In his next patent taken out shortly after, however, he dispenses with the furnace round the crucible, and instead of tapping the crucible from the bottom, he mounted it on trunnions, and by tipping it up by machinery, poured the contents from the mouth. This apparatus, devised by Bessemer, is essentially the same as that used at the present day. The way in which he worked out the process in every detail to a grand practical success in such a short space of time shows him to have been possessed of a mind of great powers of conception. Having the facts before him, he drew the right conclusions from them with unerring judgment, and from one experiment passed to another suggested by it, until with indomitable perseverence he succeeded in bringing about greater progress in the manufacture of steel in a few months than had occurred in centuries before.

It was very soon found that to produce steel by this process which would work properly, manganese, if not originally present, would have to be added. In the absence of manganese, sulphur and oxygen, in anything more than very minute quantities, makes the steel crumble when worked at a red heat; it is said to be "red short." In the case of the oxygen, the manganese combines with it, and passes it into the slag; but, with sulphur, the reaction is different; its injurious effect is simply counteracted by the manganese; it is not removed from the steel.

At first manganese was only employed in the form of spiegeleisen—a variety of cast iron, containing manganese. The use of this substance was first suggested by Robert Mushet. When, however, it was attempted to produce very soft steels, a practical difficulty arose. If sufficient spiegel was added to impart the requisite quantity of manganese, then too much carbon would have been introduced. This ended in attempts being made to produce spiegel richer in manganese. By suitably adjusting the conditions in the blast furnace, this was soon easily accomplished; and instead of spiegel containing less than 10 per cent. manganese, a 20 per cent. spiegel was produced.

At the suggestion of Bessemer, attempts were made to obtain a still richer alloy. This was accomplished by reducing rich ores of manganese with cast iron in crucibles or in a reverberatory furnace. These richer alloys are known by the name of ferro-manganese. They are employed with great advantage when very mild steel is being manufactured.

By adding at the end of the process a known quantity of spiegel or ferro-manganese, containing a known quantity of carbon, steel of any required hardness could be obtained. There was but one important drawback to the Bessemer process, and that was that phosphorus was not in the least degree eliminated by it; consequently, only the best ores could be employed, which considerably increased the cost of production over that which it would otherwise have been. I will refer to that point again presently.

The year which saw the birth of the Bessemer process was doubly remarkable, for it was at that time that the regenerative system of heating was first introduced by Dr. Siemens. Nothing can be simpler than the principle involved in this method, yet it was destined to play a most important part in the progress of the arts. The idea was to store up the heat escaping in the waste gases from furnaces, and to employ it to raise the temperature of the gas and air previous to their combustion in the furnace. This was accomplished by causing the spent gases to pass through two chambers filled with loose brickwork. When these chambers have become heated to a high temperature, the waste gases are made to pass through two other similar chambers, and the air and gas necessary for combustion in the furnace are caused to pass through the highly-heated regenerators. By causing the ingoing gases to pass alternately, at suitable intervals of time, through each pair of regenerators, a very high and, at the same time, uniform temperature can be obtained in the furnace, without any greater consumption of fuel than in the older methods. The success of this process depended entirely on the fuel being first converted into a combustible gas. This was done in a chamber to which only sufficient air is admitted to convert the carbon into carbonic oxide, which is then conducted by tubes to one of the regenerators to be heated, and thence to the furnace, where, coming in contact with air which has been passed through the other regenerator, it burns, giving out intense heat. It is at once apparent that we have here the very conditions which were wanting to make successful the process patented by Heath in 1845, for not only we have the high temperature which could not then be obtained, but it has become easy to create at will, by regulating the relative proportions of combustible gas and air, either an oxidising, a reducing, or a neutral flame.

There are two methods now in use for the production of steel in the reverberatory furnace or open-hearth as it is called. In France, pig iron and scrap steel are fused together; in England, pig iron is decarburised by means of iron ore, some scrap, however, being generally added for the sake of utilising it. As in the Bessemer process, the necessary amount of carbon is imparted to the metal by the means of spiegeleisen or ferro-manganese. This process has been largely employed for the production of ship and boiler plates. It has the great advantage that the metal can be kept fluid on the hearth, and its composition adjusted until it is exactly that required.

In 1876, a patent was taken out by M. Pernot, in which it was proposed to produce steel on an open-hearth furnace with a revolving bed, inclined at an angle of 5° or 6° to the vertical. Pig iron previously heated to redness is placed in the bed of the furnace and covered with scrap steel. The bed of the furnace is then made to revolve slowly, the pig gradually melts, and the scrap is alternately exposed to the strong heat of the flame, and then dipped under the molten pig iron. In this way the fusion is very rapid comparatively, the whole mass becoming fluid in about two hours. The process is then completed in the ordinary way. When repairs are necessary, the bed on its carriage is drawn out.

In practice, it is found that these furnaces require very frequent repairing. With the view to make this easier, M. Pernot has arranged a movable roof, which has besides the additional advantage of reducing somewhat the strain on the structure occasioned by such great variations in temperature. M. Pernot informs me that he has just taken out a patent for an arrangement of his furnace by means of which he can employ gas under pressure, and that within the last few months he has obtained by this means results which have never been equalled before. He states that, in a seven-ton furnace, he has obtained five charges in twenty-four hours. This, at any rate, contrasts favourably with the figures given by Hackney, in 1875. He says five charges, of about four and a-half tons each, are got out in each twenty-four hours; the coal used being about eight to eight and a-half cwts. per ton of steel. The averages obtained with furnaces of similar design, and working under similar conditions, but with fixed beds, he states to have been just about half, and the coal used per ton of steel to have been eighteen cwts. Mr. Holley, of New York, has recently stated that they are getting with the ordinary Pernot furnace a seventeen-ton charge in six and a-half hours, all cold stock, except five tons pre-heated scrap.

The Steel Company of Scotland tried the Pernot system and abandoned it. They appear to have come to the conclusion that, owing to the great trouble and expense in keeping the furnaces in repair, the system possessed no special advantage over the ordinary Siemens furnace. If I am not mistaken, however, the Steel Company of Scotland were using these furnaces for soft steel for ship plates, whereas, in the instances referred to, rail steel was being manufactured. This is an important difference, the temperature in the former case requiring to be much higher than in the latter, the carbon being less, and the metal, therefore, more infusible; consequently, the wear and tear and attendant expenses would be proportionately greater. Be that as it may, it is beyond dispute that this system has achieved a considerable measure of success abroad, which will probably increase, as modifications, such as I have referred to, are gradually effected to reduce wear and tear, and facilitate repairs.

We now come to the Ponsard furnace. It aims at combining the advantages of the Bessemer and open-hearth processes. The furnace is so arranged that, by giving it a half revolution on its oblique axis, the twyers with which it is supplied may be brought either beneath or above the surface of the bath of metal. By these means the metal can be rapidly decarburised nearly entirely, as in the Bessemer converter, and

ıoving the twyers from beneath the
aal adjustment of the carbon can be
the Siemens process. The only diffi-
ınced in working out this idea to a
›ess appears to be the rapid destruction
:s. This obstacle is certainly a very
nd it may possibly be found insur-

re be remarked that some firms in
indeed, in England, too, claim to be
ıce steel of any required composition
ıristics with equal exactness by the
ocess as by the Siemens. There can
doubt that much can be done in this
Bessemer process where the work is
y and carefully carried on.
ınding the fact that phosphorus can-
ıated in the ordinary Bessemer con-
nous quantities of steel have been
process, and within the last two or
ıeans have been devised by which this
steel-makers has been overcome. I
; is known as the Thomas-Gilchrist or
cess.
inary Bessemer converter the lining is
'anister, a siliceous material. Now,
greater affinity for oxide of iron than
cid has, consequently, so long as free
ent phosphoric acid cannot remain in
with oxide of iron; whilst, then, the
converter was of silica, it is sufficiently
; phosphoric acid could never be

at once say, why line the converter
ectionable substance? The answer is
bstitute was known, and the reason
ric acid was not removed was not gene-
ood.
the state of things when Messrs.
Gilchrist commenced their experi-
object they had in view was to sub-
he ganister a basic material, such as
ifficulty they had to contend with was
lining which would hold together.
failures and much patient labour, a
been found which fulfils the necessary
This material is magnesian limestone;
.t and mixing it with pitch, bricks can
'hich, after burning, are very refrac-
ing the converter it was impossible to
bricks satisfactorily together; they
: a good deal curved in baking, and
ether, and the cementing material is
l out by the molten metal. In order
his difficulty, the converters have been
ıing the material in, and then drying
in stoves the various pieces of which
· is composed. This method has proved
ıccessful.
nemy, by judicious treatment, we may
ve converted phosphorus into a friend.
process, it is essential that about 2
ilicon should be present, for it is, to a
due to the presence of silicon, that
high temperature can be obtained.
process, the less silicon there is the
use it destroys the lining by fluxing
ıre it is that the phosphorus befriends
›o, is capable of producing a high
by combining with oxygen; and that being the case, it becomes possible to work with about half the silicon necessary in the acid process, which practically means that we may employ a much lower grade of iron; for the lower the grade of iron, the smaller will be the amount of silicon in it.

So appreciated has this hitherto despised substance become, that it is actually the practice to put back into the blast furnace a great part of the slag from the converter, in order to increase the amount of phosphorus in the pig iron, subsequently to be converted into steel.

There is, however, a limit to the lowness of grade of iron which can be used, for, although the silicon decreases, the sulphur increases, and only about half the sulphur present in the pig iron can be removed in the converter. One-tenth per cent. of sulphur suffices to prevent steel from rolling in a sound condition. As I have already pointed out, the way to counteract the influence of sulphur is to employ manganese in sufficient quantity, but this is not without a drawback, for manganese is expensive.

In working out this process, much difficulty was at first experienced, owing to the mouth of the converter getting gobbed up, that is to say, stopped by projected slag. The basic slag, consisting as it does principally of lime, is very pasty. This inconvenience has been successfully got over by employing converters of the form shown on the diagram. It was predicted by many, that the slag and metal would be thrown out of the mouth of this form of converter; but that has not been the case, and it is not improbable that eventually this shaped vessel will be universally adopted for both the acid and the basic processes. Such is already the case at Messrs. Bolckow, Vaughan and Co.'s works, where, under the intelligent and persevering guidance of Mr. Windsor Richards, the basic process has first been made a commercial success in this country.

One word as regards the silicon, which, we have seen, is useful as a combustible in the Bessemer process. This substance produces both red and cold shortness in steel, which has to be worked, if present, in even so small a quantity as two-tenths per cent. But in the production of sound steel castings, it has been found to exert a very beneficial influence by preventing the metal from becoming honey-combed by escaping gases while solidifying. It exerts its influence by combining with oxygen, which would otherwise unite itself to carbon, and form a gaseous compound; the silica thus produced passes rapidly into the slag in combination with manganese, which is introduced at the same time as the silicon in an alloy containing them both.

In consequence of the extremely high temperature which we can command, either in the Bessemer or open-hearth processes, it is possible to obtain in a molten state metal practically free from carbon, or containing carbon to any required amount. It is sufficiently obvious that, having regard to the original and commonly understood meaning of the word steel, some other name should, strictly speaking, be applied to all metal manufactured by these processes, which cannot be hardened and tempered. In practice, however, there are many obstacles in the way of this being done, and it has become customary to designate by the term steel all the

metal which has been produced in a molten condition by the Bessemer or open-hearth furnaces.

It thus has resulted that we speak of steel ships, steel boilers, and steel rails. The metal of which ship plates are made contains about $\frac{12}{100}$ths per cent. of carbon, that for boilers about $\frac{24}{100}$ths, while rails usually have about $\frac{4}{10}$ths. The first and the second could not be appreciably hardened, and the third is considerably below what would formerly have been considered steel.

Although, then, metal possessing the true characteristics of steel can be made by these processes, yet that which is ordinarily made is not steel, but a metal called into existence by our recently acquired power of obtaining an extremely high temperature.

This new metal, as we may fairly call it, has properties far excelling those of wrought iron, and it has only been a question of time to make this universally felt.

At the present moment new iron rails are things of the past, and wooden sleepers have begun to follow in their wake, it having become apparent to all that our new metal will be an economical substitute. So with ships, the wooden walls of old England are no more. Steel has not only supplemented wrought iron where it was used, but the wood also.

At present there is but one sound reason why steel should not universally replace iron with advantage, and that is, that in some cases it is cheaper to employ iron. Statistics show us that the enormous quantities of steel now manufactured have but little, if at all, affected the production of wrought iron. It is, however, I am convinced, but a question of time. When the day comes, and every day brings us nearer to it, when steel will be manufactured as cheaply as iron, then will wrought iron be a thing of the past amongst the great civilised nations.

One word as regards the employment of steel made by these modern methods for cutlery. Cutlery manufacturers would tell you that it is useless for the purpose; nevertheless, on the Continent, it is very largely used, and in this country to a considerable extent. I do not hesitate to assert that, with suitable ores and proper care in the manufacture, steel well suited for cutlery can be made both in the open-hearth and the converter. The essential in the ore is that it should not contain phosphorus; with but a trace of phosphorus present, a good cutting edge could never be obtained.

I have endeavoured to show you this evening in what progress has really consisted, and how it has been brought about. If we glance back for a moment, we see that the open-hearth processes embody the same principle as the first process by which steel was produced, viz., the mutual action of carburised iron and oxide of iron on one another, and the Bessemer process is, after all, though a splendid offspring, only the natural descendent of the finery process, the origin of which, as we have seen, was due to modifications in the primitive blast furnaces. There is perfect continuity throughout, and, after all, what more natural? Progress in the art of manufacturing steel has been the joint work of the scientific chemist and the engineer. As in the past, so in the future, success will depend upon these two elements working harmoniously together.

DISCUSSION.

Mr. Michael Scott remarked that, within the
fessor Huntington had given himself, they co
have had a more complete sketch of stee
ture. He would venture to say, with regard
semer process, that as James Watt left the ste
practically perfect, so Mr. Bessemer deserved
having left, not only his process practically p
all the appartus required in connection with
were even now reverting to some of his ol
ments of machinery, finding they were better
simple than those which had since been inv
applied. With respect to the use of manganese
jected to as being expensive, but he though
another and still more important reason why
used in moderation. Dr. Siemens, on one occa
tioned it very properly as being, like char
that covered a multitude of evils. But it c
the evils, and he had reason to belie
not remove them. Not very long ago, he
specimens of steel which had been expose
atmosphere for two or three months, and th
was something perfectly alarming. He mad
with respect to the composition of the metal, an
thing he could find which could account for it
cessive dose of manganese. Manganese had
useful, and it was very important, but it had be
rather too great an extent. With regard to th
and Pernot furnaces, they had not yet been ve
ful in England, where the two great pr
Bessemer and Siemens were preferred. One
advantage claimed was that the time would
for producing a charge of steel. No doubt
produce steel in less time; but, on the
simple furnace shown in the diagram, for
process, was still supposed to be the be
regard to the Bessemer process, he had
of the very highest quality produced by it. F
as the reader of the paper had said, that i
produced for cutlery or for any other pu
it did require very careful attention. At
Bessemer process seemed to have taken the c
the rail trade, and the Siemens process the cl
the plate trade, when the amount of carb
tremely low and the tests extremely high. S
vations had been made as to the recent im
in steel, the progress had been so rapid that
only a question of years or even months, but
of weeks and days. During the recent mee
Iron and Steel Institute, in London, some
a startling character had been brought f
that those interested in the subject requir
their information up to the latest possible
reference had been made to the diagram o
which he believed represented Dr. Sieme
improvement in gas-producers. Perhaps
be rather too technical to go into it, but a
understood, it had been a great success. I
seemed to have the elements of success in it.

Mr. Shoolbred said he should like to ask
Huntington, who he believed had carried out
experiments with regard to this material calle
to give some information as to its capabiliti
structive purposes. To himself and to many
branch of the subject was becoming of grea
The question of the importance of the vast ra
substitution of steel for iron had not been un
upon, since there was scarcely any branch
was at present used where steel was n
taking its place. On the other hand,
instances which had come within his o
ledge of structural use, the expense atte
construction of steel in the ordinary forms
T, or double T, required for joists and s
taking its greater strength into consider

ly proved to be prohibitory. They were told ssibly the price might be brought down; but a ays ago he had occasion to ask one of the makers, and he found that such was not the t present. With regard to the Siemens's ative furnace, it might perhaps be interesting tion how very largely they had come into the industrial arts generally; in fact, it the use of fuel in the gaseous instead of lid state. A short time ago he had occa- make some inquiries on that head, and it inted out to him that in the year 1879, pro- no less than 3½ million tons of coal in the Kingdom were converted into gaseous fuel, by of this regenerative furnace, in various branches lustry. That showed how largely the use of us fuel was growing; and not long ago, in that room, there was an interesting discussion on the tion of using gaseous fuel in domestic arts, in t to get rid of London fog and smoke.

r. F. Maxwell Lyte said it might be interesting to t a discussion on the question of the honey-comb- which occurred in Bessemer steel castings. subject had caused a deal of discussion, and yet e never seemed to have been any satisfactory expla- on given. It had been said that silicon or silicide on being added to the metal, caused a decomposition e occluded gases therein contained, but this would ar to be not quite the case. But it seemed to him the carbon, which was capable of deoxidising silica r certain circumstances, at this high temperature, d have a tendency rather to de-oxidise any slag h might be contained, than to have its oxygen rawn from it, and so to produce a silica which d into the slag. Was it not at least equally possible under those circumstances where silicon or manga- were added to the metal, that there might be pro- a kind of alloy, incapable of occluding gases which l be occluded by a purer iron? They knew that ure metal, silver, for instance, was capable of ling oxygen gas, which it would not do when d. Perhaps some gentlemen present who had ledge on this subject, would be able to throw some on the question.

. J. S. Jeans said he should like, as one who had wed some consideration on the manufacture of to add a few words of congratulation to what had ly been said on the very excellent paper they had . If there was any defective part about it, it was, ps, the absence of any specific information as to sults of the processes which had been described, eir statistical, commercial, and industrial aspects. It t be interesting, therefore, if he mentioned the that, about 25 years ago, the total quantity of produced in the world was under 100,000 tons. was previous to the invention of the Bessemer ss. Last year, the total quantity of steel made he Siemens process and the Bessemer together over 4,000,000 tons. These figures would convey idea of the enormous progress which had been in the interval, and of the great industrial opment that these processes had contributed to about. He did not quite agree with Mr. ington, in thinking that the application of steel e future would be such as to completely displace It was never wise to prophecy unless you ened to be aware of the facts, but, having had ion recently to inquire into that matter, he found in the six iron-producing countries in the world Great Britain, the production of the manufactured had, within the last ten years, increased by r cent. Of course, that increase was nothing like ensurate with the increase which had in the same ral taken place in the manufacture of steel, but it sufficient to encourage the idea that for a great years to come, at all events, manufactured iron would continue to hold its own. He remembered an ex-president of the Institution of Civil Engineers remarking, not long ago, that, in his opinion, before many years were over, for all purposes except the ordinary working of a blacksmith's forge, steel would be used in place of iron. But they were evidently a long way from that as yet. There was no doubt that, however good the qualities of steel might be, there still remained a great many prejudices to be overcome, and recent occurrences, with which most of them were familiar, were likely to retard its progress considerably in the near future. That these difficulties would ultimately be surmounted nobody would for a moment doubt, but, at the same time, there could be no question that a great deal yet remained to be accomplished by the chemist, the metallurgist, and the engineer, before they found a metal which for all purposes, and under all circumstances, was perfectly trustworthy. He should have been glad if the Professor had shown amongst the many interesting diagrams illustrating his paper the fixed converter, which was adopted at Gefle, in Sweden, at a very early stage of the Bessemer process. He believed that there were still in operation in Sweden some fixed converters, and that on account of the great purity of the pig iron used in that country, Bessemer steel was there made without the use of manganese. They were given to understand, by no less an authority than Dr. Siemens, that it was quite within the bounds of possibility, if not already an accomplished fact, that very good steel, even the best, might ultimately be made entirely without manganese, which Dr. Siemens had described as being simply a cloak for imperfections. In the Bessemer process, however, there was no doubt that a great deal remained to be accomplished before that was attained. He should also like to hear some details concerning the manufacture of puddled steel. Even to the present day that was a considerable industry in some parts of Germany, and also in Austria and France, though he was not aware that any puddled steel was now made in this country. It was, of course, not employed to anything like the same extent as the steel made by the Bessemer and open-hearth process, which, for all practical purposes, might be regarded as the only two processes of the future. It was rather largely due to the failure that took place in connection with the application of puddled steel to ship building, that steel had not been sooner used for that purpose. Some thirty years ago a boat was built for Dr. Livingstone of puddled steel, and the Doctor sent an account of the results obtained to the Society. He found, as might have been expected from the process of manufacture, that it was a material more akin to wrought iron, laminated and heterogeneous, than to the homgeneous ingot metal with which they were now familiar, and the results of its application did not realise expectations.

Mr. Scott said there were essential differences between steel and iron. Steel was a more obdurate metal to work, and, consequently, could not be worked so cheaply as iron. In addition to that there were other considerations; steel shafting running in iron was said to cut into it; therefore there would always be disadvantages connected with its use for some purposes.

Mr. Clements, with regard to a remark made that steel would eventually be used for almost every purpose for which iron was used, said he thought that in the construction of roof trusses, cast iron would continue to be used, perhaps for ever, where there were strains of compression. He did not know exactly what the compression of steel was, but he knew the force of compression of cast iron was very great indeed. Malleable iron, cast iron, and steel, each had qualities of its own, and would be used for special purposes. He believed the Bessemer steel was very well suited for ordinary purposes, for rails and

other forms in which steel was required in the form of mass, and that Siemens's steel was more adapted for plates. With regard to honey-combing, he thought that was produced from the condensation of occluded gas, because there was no doubt that when metals were in a heated state, carbonic anhydride and oxide were present, and as the metal cooled, the gas would also cool and leave vacant spaces. The same thing was found to occur on a large scale in nature, in minerals thrown out by volcanoes. The Thomas-Gilchrist process appeared to be the greatest discovery lately made for removing the phosphorus from the steel, as made in the Bessemer or other processes. It seemed to him that there were now few discoveries yet to be made with regard to the monufacture of steel, which had arrived almost at a state of perfection, and that in the future the perfection of the metal would be more due to manipulative processes by which small quantities of impurities might be got rid of.

Mr. Joseph Gordon said, with regard to the observation made about bringing the price of iron and steel more nearly together, from what the president of the Iron and Steel Institute stated last week, it would be confessed that the prices, as far as rail metal went, were as nearly as possible together now. Taking into consideration the difference made in the tests of iron and steel plates in ship building, he did not think consumers could very well ask steel-makers to come down to the extremely low prices before paid for ordinary iron plates. In that direction, he did not think any *rapprochement* could be expected, though he trusted it would be possible to reduce the absolute price of steel in future, when the commoner ores which were found in England could be used with the expensive ores got from abroad.

Professor Huntington, in reply to Mr. Scott, said that, as regards manganese, the same remark would apply to it as to anything else; it was possible to have too much of it. If you found metal which was imperfect, which, on investigation, contained too much manganese, it was not a thing to be surprised at, when you remembered manganese was used in every process by which it was produced. Manganese was used in every process in the production of steel. It was used equally in the crucible process, by which the finest cutlery ever produced was manufactured, and in the Bessemer and every other process. Unless Mr. Scott could suggest some means of getting good steel without manganese, he feared they must continue to use it. With regard to the Ponsard and Pernot furnaces, he brought them forward because the paper was to be on the recent processes in the manufacture of steel, and they might fairly look upon them as being at any rate in the direction of progress. It was impossible to say until a process had been in use some years that it was a commercial success; there were many difficulties to be overcome which required a considerable amount of time, and an expenditure of a great deal of brain power. It required hundreds or thousands of men to be working at a process before it was brought to perfection. These processes, to his mind, had certain portions about them which might ultimately cause them to be successful. Beyond that neither he nor anyone else could speak with certainty. With regard to the use of steel for constructive purposes, no doubt it possessed very great advantages, and like everything else new, required to be studied and understood. In order to use steel satisfactorily, it was necessary that the architect should know something of the properties of the metal he was dealing with, and adjust the proportions of the metal in his structure accordingly. He had not gone far into the question, but from what he understood generally there could be little doubt that steel for the purposes of construction should undergo some modification in form, the properties of the metal being difficult to those of wrought iron. If those who were engaged in the arts of construction would give the metal a little attention, he thought a large amount of good would result. [illegible] sufficient simply to reduce the section in all p[illegible] complicated piece of metal work. As regar[illegible] combing, he had attempted to explain what was [illegible] considered to be the cause of the removal [illegible] combing as found by those who had experi[illegible] the subject. As regards the alloy which Mr. [illegible] Lyte had suggested as a cause of th[illegible] of honey-combing, he could not agree [illegible] he saw no reason to suppose that an alloy [illegible] occlude gas, when a metal would; because [illegible] from the experiments of Graham and man[illegible] that all metal occluded gas, in fact, all fluid[illegible] even the bottle of water before him, if frozen [illegible] would show a mass of bubbles of air throughout [illegible] fluids took up gas, and as the pressure and [illegible] temperature changed, so would a greater [illegible] of gas be occluded, or given off. Mr. J[illegible] had rather taken him to task for not [illegible] statistics, but he could only say that he had filled [illegible] the hour allotted to him, and when he had written [illegible] that much, he felt he should have exceeded his duty [illegible] write more. There were many other matters he [illegible] like to have mentioned, but it would have necess[illegible] detaining the meeting for a week. The figures [illegible] tioned by Mr. Jeans were no doubt interesting, and [illegible] could be found by anybody on referring to the proc[illegible] ings of the Iron and Steel Institute. He appea[illegible] be of opinion that manufactured iron would hold [illegible] own. He believed it was a question of time, and [illegible] prices coming down. As improvements were made [illegible] time went on the price would come down, and [illegible] steel, which he did not think any man conversant [illegible] two metals would deny was infinitely superior to [illegible] would replace it. Although fixed converters had [illegible] their own in Sweden, wherever new ones were put, [illegible] similar to that employed in Europe generally was [illegible] showing that fixed converters were practically thing[illegible] the past. Mr. Jeans was not quite accurate in ref[illegible] to the purity of the pig iron used in Sweden prev[illegible] the necessity of using the manganese, because it al[illegible] contained sufficient for the purpose. He had not [illegible] to refer to the puddled steel further than he had. [illegible] would only say in conclusion, that steel was a [illegible] absolutely and indisputably superior to iron, and [illegible] be used for every purpose for which wrought iron [illegible] now used.

Mr. F. Maxwell Lyte wished to explain, with reg[illegible] to his previous remark, that they knew that [illegible] pure metals were capable of dissolving gas to a [illegible] siderable extent, whereas alloys of those same [illegible] were not. One per cent. of copper would totally p[illegible] silver from dissolving oxygen, which it took up [illegible] very large quantity when in a perfectly pure state, [illegible] so would one, or even a half per cent. of gold. [illegible] ladium, by being alloyed in the same manner, was [illegible] vented from absorbing hydrogen. He only threw o[illegible] suggestion whether an alloy being formed between [illegible] and manganese might possibly prevent the absor[illegible] or cause the expulsion of the gases, and he thou[illegible] was worth investigation.

The Chairman said Professor Huntington had g[illegible] in a most lucid manner, an account of the [illegible] points in the steel manufacture. It was impo[illegible] to deal, in the space of an hour, with a s[illegible] which would fully occupy many lectures, w[illegible] omitting a point here and there which would h[illegible] been interesting to all. In connection with this [illegible] subject—honey-combing—for instance, he had not [illegible] ferred to the interesting and important result obt[illegible] by Sir Joseph Whitworth on the compression of st[illegible] but it was impossible, in the time at his dispos[illegible] have dealt with the whole subject more comprehe[illegible] That steel had made enormous strides they must [illegible] admit, but they had much to learn; they were, in [illegible] not yet quite in accord with each other as to what [illegible]

hanical engineers and chemists had engaged on the question of the l, and he believed every one would no satisfactory definition yet. Again, ne varieties of steel and the extra- modifications which it underwent o the action of heat under different effects produced by hardening and might be almost said to know gentlemen like Professor Huntington, cally and practically with these sub- looked with confidence to make outions to the knowledge of the he conditions which would insure a are of steel, and of the proper methods e would conclude by moving a cordial Professor Huntington for the excellent e had brought the subject under their ge amount of food he had given them

was carried unanimously.

COND ORDINARY MEETING.

ay 18th, 1881; F. J. BRAMWELL, .R.S., Chairman of the Council, in

candidates were proposed for ers of the Society:—

James, Farnley-house, Chelsea, S.W.
harles, 10, Henry-street, Carlisle.
lson, 14, Augusta-road, Ramsgate.
Hilton, F.C.S., 36, Rawcliffe-road, on, Liverpool.
A., Bush-lane, Cannon-street, E.C.
29, Prince's-gate, S.W.
Edward Baring, 12, Hyde-park-

candidates were balloted for, and nbers of the Society:—

ian, 57½, Old Broad-street, E.C.
. Henry Thomas, 66, Prince's-gate,
Capt. Arthur, Ashley Warren, nes.
randreth, 13, Pelham-crescent, South V.
d H., M.A., F.C.S., F.G.S., 23, helsea, S.W.
n, Fairlight-villa, Sydenham-road,
ny, F.C.S., 38, Gracechurch-street,
othy, 45, Charles-street, Berkeley-
7, Grey-street, Newcastle-on-Tyne.
liam, Hartley-grange, Winchfield,

was on—

LWAYS AND TRANSMISSION ER BY ELECTRICITY.

Alexander Siemens.

ty was first utilised for practical st of producing it precluded its nything but giving signals or nd delicate apparatus, requiring nts to perform their functions; covery of the dynamo-electric principle, some fourteen years ago, powerful electric currents have been placed at our disposal, at a cost which enables us to transform into commercial processes a number of experiments which, up to that time, served only as illustrations of scientific lectures.

The machines which have caused this revolution in the application of electricity consist essentially of two parts—the fixed electro-magnets, by which a powerful magnetic field is created, and the revolving armature, which is connected with the commutator. When the machine is in action, the rapid motion of the copper wire through the magnetic field induces an electric current, which leaves the helix by the brushes pressing against the commutator on opposite sides. From the brushes the current passes to the electro-magnets, and afterwards to the outer circuit, where it has to perform the useful work. In traversing the coils of the electro-magnets, it increases the intensity of the magnetic field, which in its turn induces a more powerful current, and this mutual strengthening of current and magnetic field goes on until a balance establishes itself in the manner afterwards described.

The researches of Sir William Thomson, Dr. Hopkinson, Professor Ayrton, and others have proved that such machines, if properly constructed, will render in the form of electrical work up to 90 per cent. of the energy expended upon them in the form of motive power. It may, therefore, be conceded that they are very efficient transformers, and that we can hardly hope to exceed the results already obtained by the best types of dynamo-electric machines. If, instead of using such a machine to generate electricity you send a current into it, the magnetic attraction created between the poles of the electro-magnets and the currents traversing the armature will cause the latter to rotate, and this motion can be communicated to other machinery in the usual ways. A pair of such machines, one for producing electricity and the second for re-transforming the current into motive power, can therefore be utilised for transmitting power to a distance. In order fully to understand the manner in which this transmission is effected, a large number of experiments were made at the works of Messrs. Siemens and Halske, in Berlin, by Dr. Frölich, and the results obtained were laid before the Royal Academy of Science in Berlin by Dr. Werner Siemens on the 18th November, 1880.

The principal conclusions arrived at were the following:—On applying Ohm's law to a magneto-electric machine (a machine with permanent magnets) we find that the strength of current for a given total resistance is—

$$\text{(1.)} \qquad C = \frac{n \times M \times v}{R}$$

In this formula C signifies the strength of current; n, the number of convolutions of wire on the armature; v, the number of revolutions per minute; R, the total resistance in circuit; M, the total E.M.F. produced by the permanent magnets and the iron of the armature in one convolution of wire, when $v = 1$; this quantity will afterwards be called "effective magnetism" of the machine.

The same formula holds good for a dynamo-electric machine. In this case, however, the "effective magnetism" (M) depends on the

strength of current (C), and the formula, by substituting f (C) for n (M), becomes—

$$(2.) \qquad C = \frac{v f(C)}{R}; \text{ or } \frac{C}{f(C)} = \frac{v}{R}.$$

In the latter form, the very important law is expressed that the strength of the current in a given dynamo-electric machine depends only on the ratio of the number of revolutions per minute to the total resistance in circuit. If we determine, therefore, f(C) for a machine, we can calculate beforehand the strength of current it will produce with a given number of revolutions in a given resistance.

The first series of experiments was made to test the correctness of this conclusion, and the curves I., II., and III., embody the results obtained by working one of the largest "Siemens'" dynamo machine (type D_0.) through various resistances at diffierent speeds. The total resistance of the machine was, in case (I.), ·435 S.U.; in case (II.), ·725 S.U.; and, in case (III.), 7·14 S.U.

By way of comparison, the curve IV. was set out from results published by Messrs. Meyer and Auerbach in "Wiedemann's Annalen," Band 8, p. 494, who had experimented with a "Gramme" dynamo machine. As will be seen, all these curves do not differ materially from a straight line, and, for the limits of practical working, they fully confirm the above theory. There exists, therefore, a curious similarity between magneto-electric and dynamo-electric machines. In both, the strength of current is proportionate to the ratio of revolutions per minute to total resistance, although the magnetism of the magneto machines is a constant quantity, and that of the dynamo machines varies with the strength of current. The important difference between the two kinds of machine is, that magneto machines give a current however slow their motion is, whereas dynamo machines only begin to give a current when the ratio of number of revolutions to total resistance attains a certain magnitude.

The nature of the f (C) was then further examined, and the influence on the magnitude of the "effective magnetism" of the currents set up in the iron of the armature by its quick rotation in a magnetic field, and by the currents traversing the coils of the armature. The results arrived at are represented by the curves V., VI., VII., for the large Siemens machine, and by the curve VIII. for the Gramme machine referred to above. They show that at first the "effective magnetism" increases in proportion to the increase of current, then it deviates more and more until it very gradually reaches a maximum, and for still more powerful currents it decreases again. The latter peculiarity is to be accounted for by the fact, that the iron bars of the electro-magnet cannot be magnetised beyond a certain point, whereas the diminishing influence of the currents on the magnetism in the iron of the armature increases continually with the strength of these currents. In practical applications such powerful currents are seldom met with, and it will suffice for the present purpose to assume, that the "effective magnetism" gradually approaches a maximum.

When two machines, identical in their construction, are connected to transmit power, the "effective magnetism" in both should be equal, as the same current circulates through both of th following equations will, therefore, exi the various quantities :—

$$E_1 = n\,M\,v_1;\; E_2 = n\,M\,v_2;$$

$$C = \frac{E_1 - E_2}{R} = n\,M \times \frac{v_1 - v_2}{R}$$

$$W_1 = a \times E_1 \times C = a\,C^2\,R\;\frac{v}{v_1 -}$$

$$W_2 = a \times E_2 \times C = a\,C^2\,R\,\frac{v_2}{v_1 -}$$

$$H = a \times C^2 \times R;\; W_1 = H + W$$

$$N = \frac{W_2}{W_1} = \frac{v_2}{v_1} = \frac{E_2}{E_1}.$$

In these formulæ the index 1 ref machine producing the current, and t to the machine giving out the power for electro-motive force; n, M, v, R the same quantities as before; a is depending upon the construction of the H is the heat, generated in the system work expended upon the primary mac the work given out by the secondary is the useful effect.

In comparing these formulæ with o it is easily seen that they cannot be q This is most conspicuous with the form useful effect, $N = \frac{v_2}{v_1}$, according to should be greatest the more the vel second machine approaches the velocit machine, whereas actual experiments is a maximum for a certain velocity o machine, and will decrease for any lesser number of revolutions of the machine. The cause of this discrep influence of the so-called Foucault' which are set up in the iron of th armatures by the proximity of the powe magnets.

In the primary machine these curre in the same direction as the currents i ing wire of the armature, and by wea "effective magnetism," and, conseq E_1M.F — E_1, they increase the work W upon the primary machine. In the machine, however, in which the armat the opposite direction, these Foucault cu late in the opposite direction to the cur armature wires, and by thus strengtheni tive magnetism and the electromotiv they diminish the work W_2, given secondary machine.

As our machines are supposed to be construction, the following formula w the relative proportion of the differe ties relating to the Foucault currents:-

$$M_1 = M - \alpha c_1;\; M_2 = M + \alpha c$$

$$c_1 = \frac{M_1\,v_1}{u} = \frac{1}{n}.\frac{E_1}{u};\; c_2 = \frac{M_2\,v_2}{u} =$$

M signifies the effective magnetism, would be, if no Foucault currents existe M_2, the actual effective magnetism machines; c_1 and c_2, the strength of th currents; u, the resistance through w currents circulate; v and n, having the sa

and c being a constant, depending on
action of the machines.

alculate from the above equations the
M_1 and M_2, substituting at the same time

we have:—

$$= M(1 - y v_1);\ M_2 = M(1 + y v_2);$$

the electromotive force of the two
-

$$= n M_1 v_1 = n M (1 - y v_1) v_1;$$
$$= n M_2 v_2 = n M (1 + y v_2) v_2;$$

us for the current—

$$\frac{- E_2}{R} = \frac{n M}{R} \left[v_1 - v_2 - y (v_1^2 + v_2^2)\right];$$

e work expended and given out respec-

$$W_1 = an\, CM_1 v_1 + ac_1 M_1 v_1;$$
$$W_2 = an\, CM_2 v_2 - ac_2 M_2 v_2;$$

ibstitute $p = \frac{a}{n_2 u}$:

$$a\, CE_1 + p E_1^2;\ W_2 = a\, CE_2 - p E_2;$$
$$= \frac{W_2}{W_1} = \frac{E_2}{E_1}\left[\frac{1 - p (E_1 + E_2)}{aC}\right];$$
$$(E_1 - E_2);\ F_1 = p E_1^2;\ F_2 = p E_2^2;$$
$$W_1 = W_2 + H + F_1 + F_2.$$

rmulæ the symbols have the same signi- before, and F_1 and F_2 signify the work ne Foucault currents.

ctrical quantities E_1, E_2, and C admit of neasurement, and by the help of the mulæ, the quantities W_1 and W_2 can ined beforehand, when the constants of nes are known.

number of experiments were then made, all the quantities were measured, and the esults were compared with the quantities from the above formulæ, and it was it they agreed very well. It is hardly to observe that these formulæ are appli- all types of dynamo-electric machines, their construction may be, the character be determining the constants.

a of utilising these machines for trans- f power presented itself to Dr. Werner as long ago as 1867, when he discussed Paris Exhibition with other members ary the possibility of elevated electric but the dynamo machine was at that sufficiently developed to admit of a execution of the idea, and when the ore perfect forms were invented electric monopolised for a time all the attention bestowed upon the practical application chines.

the efforts which have been made to in- ectric lighting on a large scale, the idea ig the light-giving machines during day- istribute power, has come to the front l as such an application means a further of the invested capital, the combination g with transmission of power is sure to

is purpose a central station has to be d in a district, in which powerful steam- working on the most economical princi- a number of dynamo machines, which produce the electric currents. Secondary batteries, similar to those constructed by M. Planté, and improved by M. Faure, may be employed to receive the electricity, and keep it ready for use in the same manner as the gas is stored in large gas-holders, and as accumulators are used in connection with hydraulic machinery.

From the station cast-iron pipes are laid through the streets, similar to those now in use for distributing gas or water, and insulated wires are drawn into them for conveying the currents from the machines to their destination. At convenient intervals the wires are made accessible by so-called "road boxes," inserted in the pipes, from which the connection to houses or lamp-posts can be made. Two separate sets of wires would be required for the lighting and for the transmission of power, the commutators, for directing the currents, being placed in the station; and additional commutators could be fixed in the houses for switching the current from secondary machines to lamps, without communicating with the station.

There is, no doubt, that much has to be learnt before all the details of such a central station, and of a practical system of distribution have been brought to perfection; but there are, nowadays, few obstacles that cannot be surmounted, and even our present knowledge is advanced enough to teach us that there is nothing impossible in the idea sketched out above.

When a certain amount of power has to be transmitted by electricity to the given distance, it is easy to determine, experimentally, what power is required to drive the primary machine, as the exact conditions, under which the trial was conducted, can be readily reproduced in the practical application. In this respect, the transmission of power by electricity possesses a great advantage over the transmission of power by water or air, as the friction and leakage of the pipes, through which the latter have to be conducted, can never be determined in advance. It further has the advantages that the secondary machine works without producing any waste, which has to be disposed of, and that the small size and low weight of the machines obviates the necessity of heavy foundations for them.

In considering the possibility of employing the electric current to distribute power from a central station, the proportion of the power given out by the secondary machine to the power expended upon the primary machine, will not be of that deciding influence, as is generally supposed. Granted even that not more than than 45 per cent. of the power expended can be reclaimed, it will still be possible to produce the power required at a cheaper rate, than if each small place had its own steam-engine. For, at the central station, 1 h.p. could be produced by the large steam-engines with about 2¼ lbs. of coal, so that 1 h.p. given out by the secondary dynamo machine would be produced by burning 5 lbs. of coal per hour. There are few small steam-engines which will produce a horse-power with that expenditure of fuel, and if we take into account the trouble and risk connected with the running of steam-engines, it may be readily admitted that this loss is no real obstacle to the introduction of the electrical transmission of power. Of still less consequence will this loss be

where waterfalls or other natural forces can be employed to drive the primary machines, in which case the power would cost practically nothing, beyond the interest on the capital and the depreciation of the machines. The applications which it has hitherto found have, to a certain extent, been of a tentative nature only, and on a small scale, but they are nevertheless very instructive, as they show that economical results can be obtained by it.

About three years ago, Sir William Armstrong erected a turbine at his country seat, Craigside, near Newcastle, and drives by it a Siemens dynamo-electric machine, the current of which is conducted to his residence about half a mile distant from the waterfall. In day-time this current transmits the power of the turbine to the house, where it is used for various purposes, and at night it is converted into light by means of "Swan" lamps, of which it works between thirty and forty. This application deserves special mention, because it is one of the earliest examples of transmission of power by electricity for practical and permanent purposes.

In the same way Dr. Siemens utilises some dynamo machines at his country house near Tunbridge-wells, the power to drive the primary machines being, in this case, obtained by means of a Tangye "Soho" steam-engine. The waste steam from the engine is utilised to warm the hot houses, and the gardener attending the houses takes also care of the steam-engine and the dynamo machines driven by it. In this way the cost of fuel and of attendance is reduced to a minimum.

The electric current is utilised during the whole of the night to produce two lights, by the influence of which various fruits and plants are growing; and the current, in daytime, from one machine sets in motion a similar machine, which works the chaffcutter, and some other machinery, at the farm about a quarter of a mile away from the hothouses. The current from the other machine is conducted to the pumping-house, a distance of about half a mile, and the secondary machine there has supplanted a small vertical steam-engine that used to pump the water up to the house. In this case, the return conductor is formed by the wire fence, care being taken to connect the wires from one side to the other of the intervening gates.

By these arrangements, one man at the farm can do the work of three; and, instead of a man having to drive a steam-engine at the pumping-station, to say nothing of transporting coals there, and losing time in getting up steam, he can set the pump in motion without going near the place, an occasional visit only being required for refilling the lubricators.

There are many similar instances, in which it is advantageous to connect a number of small machines, which work at irregular intervals, by means of the electrical transmission of power with one steam-engine, not only when the distance between the machines is considerable, but also when they are comparatively close together.

Several applications of the latter nature have been made at Messrs. Siemens's works at Charlton; among others the apparatus for testing the mechanical strength of cables, is set in motion by a dynamo machine; and a small pump, which keeps the water in circulation in the core-tanks, is driven by another machine. In both cases it would have been more costly to transmit the necessary po in the usual way by shafts and belting. A f months ago a machine was placed upon a on the wharf, and it was found that by it could be lifted about 12 feet per minute, and weights proportionately quicker. It is only add, that the crane was not constructed for th purpose, and that the arrangement was made with the view to demonstrate the possibility working cranes by electricity, than to obtain best results.

The electrical transmission of power, on acco of the compactness of the machines, and the with which the conducting cables can be shif is particularly adapted to be used in cases w the driven machinery is erected only for tempo purposes. As an example, it may be menti that, when the cable ship *Faraday* was l the works of Messrs. Siemens, the machiner which the cable is pulled on board, was drive of the time by a dynamo-electric machine.

Another illustration of the same kind was nished by M. Felix, of Sermaize-les-Bains (M who worked, in June, 1879, one of How double-furrow ploughs by a Gramme dy machine. The motion was conveyed fro electrical machine to a drum, and thence by of wire to the plough. There was no stopp any kind, but the plough did its work st digging up the ground to the depth of abou inches. In the following year, M. Felix s at the local agricultural exhibition at Bar-le plough and a threshing machine, both wor electrical transmission of power, with success.

As mentioned above, one of the first thou Dr. Werner Siemens was to employ dynamo- machines for working elevated railroads, bu only about three years ago that he was ind take the matter into serious consideration, owner of a coal mine asking him to design motive to draw the coal waggons in the mi result was that Messrs. Siemens and Halske at the Berlin Exhibition, in the summer o the model of an electric railway, which ha been exhibited at Düsseldorf and Brussels, at present working in the Crystal Palace total length of this circular railway was at 300 metres, and the gauge one metre. A d machine, mounted on a carriage by itself, as locomotive, and the passengers were co in three carriages, each having seats for six p The current was conveyed from the primary m to a rail laid between the rails on whi carriages run; thence it was taken off by b fixed to the machine and sliding on the rail, it returned to the primary machine outer rails. When the carriages were pre from moving, the locomotive exerted a pull of 4 cwt. (200 kilos.) on them; and when the tra in regular motion, the pull varied between 1 and $1\frac{3}{4}$ cwt. (70-80 kgr.), which represents, speed was about 10 feet (3 metres) per s three-horse power.

Small as the railway was, it clearly demons that such a mode of transport is feasible; advantages of having light carriages, of bein to propel them without noise and smoke, in Messrs. Siemens and Halske to lay before authorities in Berlin a plan to make an ele

through one of the streets in Berlin, ar about 6¼ miles (10 kilom.) long. the kerbstones of the street, iron columns, y two-channel irons, were to be erected, yards apart, carrying wooden sleepers on ch, in their turn, support longitudinal To ensure the stability of the structure, truts keep the girders apart, and serve, at time, to insulate them from each other. height, from the level of the street to side of the girder, is about 14 ft. 6 in. e), and the depth of the girder about cm.) Steel rails are laid on top of the d the girder and rail on one side serve ductor from the primary machine, and rail and girder form the return wire; in the electrical resistance of the line is a very low figure.

ge of the line was to be one metre, and ges, resembling ordinary tram-cars, were out 5'·5" broad (1·65 m.) and 8 feet high above the rails. The dynamo laced out of sight, underneath the car, e motion by means of belts to the two hich have to be insulated from each the current arrives through one rail, ough the machine, and returns by the as described above.

d at which these carriages were intended 30 kilometres (18·6 English miles), and n were to be supplied for the railway, of would be in use, and four in reserve, being required to drive the primary f each carriage. The cost was carefully t, and, as it serves as an indication what ays may be expected to cost, a short of the principal items will not be out of

f 10 kilometres (6¼ miles), elevated railway, single line.

elf, including 10 stations..........	£61,000
es, to hold 15 persons each	3,150
steam-engine and dynamo-machine	1,950
....	1,185
....	4,500
enses	715
	£72,500

11,600 per mile.

mate includes the cost of erection of the d of the station, at which the steam-orks, together with the necessary o protect the rolling stock against the hen it is not used. The cost of working y was calculated to be, for one year:—

Current Expenses.

....	£2,190	
....	1,110	
te........................	50	
....	80	
		£3,420

Depreciation and Repairs.

,500 (railway and buildings)	£1,875	
000 (carriages and machinery)	800	
		£2,675

Interest on Capital.

,500	£3,625
ost per annum....................	£9,720

£ 6s. per English mile per day.

The intention was to run about 200 trains per day, and if the charge of 1d. per mile had been made, the £4 6s. per mile could have been earned, if on the average five or six persons had been conveyed in each case. The concession for this railway was not granted, partly because the inhabitants strongly objected to having people looking into their first floor windows, and partly because the Emperor did not wish to see "The Linden," which this electric railway was to cross, disfigured.

Subsequently, Messrs. Siemens and Halske obtained permission to build a railway on the ground level from Lichterfelde, a suburban station on the Berlin-Anhalt Railway, to the Military Academy, and this railway has just been successfully opened for regular traffic. It is a single line of 1 metre gauge, a little over 1½ English miles long. The permanent way has been constructed in exactly the same way as that of railways; wooden sleepers and steel rails are employed, the rails being connected, in addition to the usual fish plates, by short straps of iron, bent in the shape of a bridge, so as to admit the adjustment of the rails to different temperatures, and to reduce at the same time the electrical resistance. As the currents are low tension currents, it was not necessary to provide further insulation, and no difficulty is experienced in using one rail as the positive, and the other as the negative conductor.

About a third of a mile from the Lichterfelde station the primary machine, with its steam-engine, is erected in the engine-house of the water-works, and the current is conveyed from there to the rails by underground cables. The car is exactly similar to an ordinary tram-car, and is constructed to hold 20 persons besides the guard. It is symmetrical, and can move backward and forward, each end being provided with a starting lever for the guard, a brake handle, and a signal-bell. The dynamo machine is placed underneath the car, and transmits its movement to the wheels by means of spiral steel springs. The tires of the wheels are insulated from their axles, and are in electrical connection with brass rings, fastened on the axles, but insulated from them. Contact brushes press against these brass rings, and from them the current is conducted to the dynamo machine, and sets it in motion.

The authorities were, for some time, doubtful how to class this novel railway, and after long deliberation they have decided to rank it as a one-horse tram-car. In consequence of this decision, the average speed on the railway must not exceed 9·3 English miles (15 kilometres) per hour, and the greatest speed at any moment must not exceed 12·4 English miles (20 kilometres) per hour. The time for traversing the whole distance is, therefore, not to be less than ten minutes, although the car could make the journey in about half the time with perfect safety.

If the railway continues to work in a satisfactory manner it is to be extended, and there is no doubt that the success of the railway at Lichterfelde will greatly assist in the further introduction of electrical railways, either on the level of the streets, or elevated, like the steam railways of New York. Over any other system, worked by steam or by compressed air, the electrical has the advantage that no heavy machinery has to be carried about to set the train in motion. The

carriages can, therefore, be built in a lighter manner, thus reducing the power necessary to move them, and permitting all bridges and other superstructures to be built more cheaply than usual. Several carriages, each with a dynamo machine, can be joined to one train, and by this distribution of the motive power much steeper inclines can be overcome than when the same train is drawn by a single locomotive.

In addition to the ordinary brakes, means can be provided to short circuit the machines on the carriages, and to cause them in this way to act as very powerful brakes. The use of large stationary engines reduces the amount of fuel necessary to develop a certain power on the travelling carriage, and if waterfalls can be utilised, the cost of working these railways will be further diminished. It seems, therefore, probable that such railways can be usefully and economically constructed to facilitate the traffic in crowded streets, or in situations where local circumstances favour their application.

From all that has been done during the last few years, it is quite evident that the art of transmitting power by electricity has advanced rapidly, and that its practical application is continually gaining ground. This, however, should not be regarded as a sign that the electric transmission will supersede every other system of transmitting power to a distance, but rather that there is a sphere for it, where it meets existing demands better than our present means; and it should, therefore, not be treated as an enemy of existing systems, but as a supplement to them, by the aid of which problems can be solved, that could not otherwise be attempted.

DISCUSSION.

The Chairman said the subject brought before them that evening was one which, though of the highest importance, had been presented in a modest unassuming manner; but there was in the paper matter for very deep consideration. The great utility of some means of transmitting power to a distance had long been recognised, and must be appreciated by all who thought on the subject. The same argument was frequently made use of which had been advanced to-night, that if power could be laid on to houses in small quantities, it might turn the course of industry from the system of large factories to a system in which each workman might work in his own dwelling; but he was not at all prepared to say that such a change, except in special cases, was desirable. The probability was that the workman would have bad ventilation, that he would not attend to his duties so well as he would in a large factory, and that all the economies arising from a well-organised establishment and the sub-division of processes would be done away with, the only advantage being the somewhat sentimental one, that the man worked in his own house. However, this was rather a question for the political economist than for an engineer. Attempts at transmitting power from a distance had been made for many years. He was apprenticed to an engineer (John Hague) who was the very earliest to make the attempt on a large scale. His mode was the exhaustion of air by pumps worked by water-wheels or other suitable prime movers, the exhausted mains being connected to engines in the nature of a steam-engine, and the pressure which the atmosphere exerted on the piston caused it to work. In that way power was conveyed very well indeed—considering the time at which it was done—and very usefully. Notably, it was conveyed to underground engines in coal mines, where it
provided a motor free from the objections of
engines in such positions; it was also conveye
a steam-engine into gunpowder manufactories, t
obviate the necessity of fires within the m
Since then they had had the transmission of p
compressed air, and also by water under p
perfected by Sir William Armstrong, by means of
mulators and various hydraulic engines. He
quite agree with Mr. Alexander Siemens, that t
advantage in the electric mode of transmission o
last two, lay in the fact that with them the
friction and leakage could not be accurately cal
because the loss by friction was easily calcul
that by leakage was dependent on the care wit
the work was carried out, and it ought to be, i
fact, extremely small. Then again, there was t
mission of power by means of endless ropes,
there was a magnificent example at Sch
where the water of the Rhine was made
large turbines which drove endless ropes; t
carried about three-quarters of a mile along
of the river, and drove shafting under the st
from which the power was laid on to vario
and he did not know a more interesting sig
see the power of the Rhine thus utilised.
evening we had before us a means of tr
power by electricity, and no doubt if such
conductor as was on the table could be
for the large exhausted main of John Hag
smaller main carrying compressed air, o
smaller one carrying water under press
the rope running over guide pulleys, a
would be gained. Mr. Alexander Siemens
that this mode would be economical eve
only 45 per. cent. of the power develo
steam-engine was available at the spot
was utilised, and did so, on account of
economy in working one large central st
rather than a number of small ones, and
quite agreed with him, as also in the sta
$2\frac{1}{4}$ lbs. of coal per h.-p. was a liberal allo
large condensing engine, and that at least
used in small non-condensing engines. I
pointed out that where water-power was
might be utilised in a manner which it co
present, as, instead of factories having to
inaccessible, out of the way places, the dyna
could be placed there, and connected by w
where the manufactures could be carr
comfort, and where transport was easy
had the good fortune to see the arra
Sir William Armstrong, at Craigside; t
fall of water which drove the machine, th
led to the house nearly three-quarters of a m
during the day the force was employed to
bench, and at night for illuminating the
had not been there since the Swan lights
duced; but Sir William Armstrong wrote to l
of months ago, saying that the lighting had
improved since he saw it. Sir William stat
light was perfect, so much resembling dayli
the time of writing, he had even been obl
up and draw the curtains, because there w
outside trying to commit suicide by comi
the window. It appeared that the authoriti
did not know how to classify this new ra
their putting it down as a one-horse tram-c
him of a curious classification he heard of m
when he visited the celebrated cavern near Tr
was lit by candles, and the landlord of the
plained that the electric light had been pr
the Prefect objected, citing a resolution whic
passed by the authorities, that neither
electricity, nor any other smoke-producing
illumination should be employed. With
another mode of using electric force, whic
touched upon in the paper, he might say t

ing a most agreeable perfume coming the table before him, which Dr. Siemens the sun, aided by electricity; and he t would prove as good as other fruits m the same source. In this paper they g out of a subject, the importance of ficult to exaggerate. If, by means of could practically convey power to a ve it forth when required in anything le proportion of the power originally as perfectly certain that they had as of utilising the forces of nature, wasted. All round England they had ed and flowed with varying range, but rage would be about 15 feet; and if they of water mills, utilise that enormous transmit it electrically to centres of must economise the coal now employed of motive power, and reserve it for those ich, up to the present time, it would was needed, viz., for metallurgical and irposes. At the same time he by no l of hearing that it was no longer even for these operations, for it was ppear that electricity was able to do ay of melting refractory materials, rto been done by the expenditure of fuel. he paper was so large and important, it would not be too much to ask the Society to devote next Wednesday tinuance of the discussion.

ton said the first point which occurred g the paper, was in connection with the ich Mr. Siemens arrived at the result cy of electrical transmission ought to ium when the velocity of the motor was the generator; but who went on to say ed to be something wrong in this theo- n, because it was not borne out by experi- planation given was the Foucault currents p by induction in the iron. He ventured as another explanation altogether which or the formula not according with ex- ts, and indeed he should not have pre- formula would agree with the results. at the experiments to which they re- de with dynamo machines, in which nerated by the machine was used to magnets. Now, supposing they had ctric machines, one driven by a steam- ducing a current, and the other pro- y means of that current, and imagine t exactly the same speed, what would There would be no current whatever ire joining them; because, if running peed, the electro motive force of the be equal and opposite to that of the motor. as even little current passing between nes, it was impossible for the second ive power at all, since there could be on of the field magnets. And yet for evolve rapidly work must be spent in no useful work were given out; hence e use of dynamo machines which caused result to differ from the practical. The ought to be used were either dynamo- s with separate exciters, or else magneto- es. For the transmission of power effi- omically it was absolutely necessary that ion of the field magnets should not be current passing through the wires join- hines. But when such an arrangement as as carried out, there would be little differ- theoretical and practical result. It would e economy of the transmission increased of the motor more and more approached that of the generator; and when both velocities were extremely high, and nearly equal, the efficiency would approach very nearly to 1. There were various con- siderations which would bear this out. If you made experiments, as his students had done, with magneto- electric machines as motors, measuring the electric energy put into the magneto-electric machine, and at the same time measuring the amount of work given out by it, you did not find that there was a maximum point after which the efficiency diminished. All the experi- ments he had seen showed that the efficiency increased with the speed; and he had actually obtained with a very high speed an efficiency of 92 per cent. He thought, on the whole, the conclusions Mr. Siemens had arrived at tended to show what Professor Perry and himself had advanced several times, that they ought to use either magneto-electric machines or dynamo machines, with separate exciters; and, to a certain extent, this conclusion was borne out by practical experience, because he learned that in electric lighting, which was but one mode of transmitting power. it was becoming the practice to use separate exciters for the dynamo machines; and that was the method adopted by Dr. Siemens in the City. As the Chairman had pointed out, the great advantage of electricity as a means of transmitting power was not that the friction and leakage inseparable from other methods could not be calculated; but experiments seemed to show that electricity had no mass; that there was no inertia in it; and there was no waste of power in making it go round a corner, as there was with water or any kind of material fluid. In many respects, of course, the flow of electricity through a wire was like the flow of water through a pipe; the quantity of current was constant, and the electricity lost potential, just as water lost head; but there was this great difference between the two, when you had to make water go round a bend you lost a great deal of power, and the form of the bend made a considerable difference. If you had two or more bends in a pipe, in opposite directions, you lost more power than if there were a continuous curve in the same direction; but this was not so with an electric conductor, since bends made absolutely no difference in the electric re- sistance of a wire. The Chairman had alluded to the great advantage which would result from an enor- mous quantity of waste power being utilised, and with that he concurred, not so much with regard to the tide, the utilisation of which he feared lay in the dim future, in consequence of the great expense of storing the water when the tide rose, but rather with regard to the water-power of streams. It was quite lamentable to walk about the neighbourhood of Sheffield and see the number of old grindstones which formerly were worked by water-power, now lying idle, the grinders having all gone into Sheffield, where they used grindstones worked by steam-power, which cost them more; but they saved, on the whole, on account of the expense of transportation. If those streams could be used to work magneto-electric machines, from which the power could be conveyed into the town, and there utilised, it would be an immense advantage. There was another point about electric railways which might not have struck some of those present. At present locomotives weighed from 40 to 60 tons, necessitating very substantial and expensive bridges and permanent way, and it was impossible to make them much lighter, or they would not have sufficient adhesion on the rails to pull a train; you could not much diminish the weight so long as you drove a train by one or two pair of driving wheels. But if you drove the train by nearly all the pairs of wheels, as could easily be done electri- cally, it might be made comparatively light, and there would be no loss by slip. The great value of the paper lay in its technical character; it was a laud- able example of the application of principles of science to practice, which characterised all the work of the Messrs. Siemens; and if he had ventured to differ a little

from some small part of the theoretical considerations advanced, he would conclude by assuring the meeting that no one more highly appreciated its practical bearing.

Mr. J. N. Shoolbred said he had made some experiments on the transmission of power, and was much struck by the remarks of Professor Ayrton on the amount of useful power the formulæ disclosed, and also as to the nature of the machines which, in his opinion, would have to be employed. He agreed with him as to the errors, which had probably arisen from the use of two dynamo machines, one as the generator and the other as the motor. He had himself long seen reason to doubt the ordinary statement that there must be a loss of 50 per cent. in the second machine, and he hoped, by some means or other, they would be able to discover the proper formula. With regard to the two classes of machines, spoken of by Professor Ayrton as the best form of primary machines, either magneto machines or dynamo machines with separate exciters, he thought—especially where the same machines were used for lighting and for transmitting power in the daytime—that dynamo machines would be chiefly employed; but they would generally fall under the condition of having one common exciter, and, consequently, according to Professor Ayrton, about 80 per cent. of the original duty given off might be recovered.

Professor Ayrton wished to explain that the figures he had used, and which were quoted in the paper, did not mean that if you gave a certain amount of power to the dynamo-electric machine you could get out 90 per cent. of that in the electric light produced by that machine; it only meant that 90 per cent. of the power given to the machine was reproduced as electric energy. Some of that energy was employed in producing light, but a large portion—often nearly half, or more—was employed in heating the wires or the magnets.

Dr. C. W. Siemens, F.R.S., said he would only make a few remarks that evening, and speak more at length when the discussion was resumed next week. Professor Ayrton had remarked that the dynamo machine would be superseded by the magneto machine, or by a dynamo machine with a separate exciter, and he confessed that he went a long way with him in his argument; indeed, last year he communicated a paper to the Royal Society in which he showed certain defects in the dynamo machine, and suggested certain remedies. The dynamo laboured under this defect, that, with an increase of work, the power to overcome the resistance diminished. The current produced by the rotation of the coils in the magnetic field had to excite the coils of the magnet itself, and the current then passed on to the second machine or to the light, to the place where the work was to be performed. Now if that work should present increased resistance, the machine which had to overcome it should increase in energy, whereas the greater resistance caused a weakening of the current and a falling off in the power of the magnets by which the current was produced, thus causing those fluctuations which were so troublesome in electric lamps, but which, by different arrangements, had been almost overcome, and would be entirely overcome by the aid of further experience. It was quite true that in the City they were working with dynamo machines having separate exciters, but the dynamo machine could be so arranged that a portion only of the current was set aside to excite its own magnet, and if that arrangement were properly applied, he believed all the advantages of a separate exciter could be secured with a single machine. The subject especially before them, however, was the application of electricity to the propulsion of railways and the transmission of power, of which the propulsion of carriages was only one branch. Several other methods by which propulsion could be effected might be mentioned. Only a few days ago he had been in Paris, and had arranged for the construction of a short line of comparatively broad gauge, which was to be carried out by the omnibus company of Paris, in connection with the Electrical Exhibition. An ordinary tram-car would be run from the Place de la Concorde to the Exhibition, upon rails laid in the usual manner, having a suspended conductor along the side of the railway. This conductor would have a little carriage passing along it, in order to transmit the electric current from the suspended wire to the machine, and back through the rails themselves. That arrangement, which was devised by Dr. Werner Siemens, made them independent of partial insulation of the rails upon which the carriage ran, and also independent of the partial insulation of the wheels of one side from the other, leaving the rolling stock very much the same as at present, transferring the current to a separate conductor, something analogous to a single wire telegraph, upon which the contact roller ran and conveyed the current to the machine. Another arrangement by which an ordinary omnibus might be run upon the street would be to have a suspender thrown at intervals from one side of the street to the other, and two wires hanging from these suspenders; allowing contact-rollers to run on these two wires the current could be conveyed to the tram-car and back again to the dynamo machine at the station, without the necessity of running upon rails at all. He merely mentioned this to show that the system was not one which must be carried out in one particular way only, but was capable of very w[illegible] modification and extension according to circumstances. The paper referred to certain applications which he [illegible] made of electricity, near Tunbridge-wells, to horticulture, and on the table was a melon which had [illegible] produced by the aid of the electric light. He h[illegible] the Chairman would take it home, and report up[illegible] next week.

The Chairman said if it turned out as good as [illegible] electrically-grown fruit which he had tasted, his [illegible] would be far from a disagreeable one. He then [illegible] clared the meeting adjourned until Wednesday ne[illegible]

MISCELLANEOUS.

BRUSSELS INTERNATIONAL EXHIBITI[illegible]

This Exhibition, due to private initiative, was st[illegible] with the object of receiving foreign products [illegible] inventions which were not admissible at the p[illegible] national exhibition in the Champ des Manœu[illegible] The Palais du Midi, which was originally [illegible] for a market, was completed with a special [illegible] to its present destination, and formally opene[illegible] the King and Queen of the Belgians, accomp[illegible] by Sir Savile Lumley, the British Minister [illegible] 1st June, 1880. It was intended to be permanent; [illegible] the great falling off in attendance during the w[illegible] months has induced the committee of manageme[illegible] terminate the present exhibition with its first ye[illegible] existence, and on 1st June next to open the first [illegible] series of annual exhibitions, from June to Octo[illegible] with special classes, varying each year.

The classes fixed upon for the present year are: [illegible] Carpets of all kinds, including felt, mats, and in[illegible] rubber; 2. Tapestry and other fabrics connected [illegible] furniture, including American cloth; 3. Uphols[illegible] curtains and hangings; 4. Works of the decorator, [illegible] cluding plaster of Paris, carton-pierre and pa[illegible] mâché; 5. Shawls; 6. Lace and tulle; 7. Mil[illegible] trimmings and embroidery; 8. Dress and its accesso[illegible] 9. Ceramic ware, both porcelain and pottery; 10. G[illegible] and crystal ware; 11. Window and stained g[illegible] mirrors, &c.; 12. Art bronze, zinc, and iron-w[illegible] lighting and heating appliances; 13. Goldsmiths' w[illegible]

lery; 15. Arms and cutlery, including surgical ts; 16. Musical instruments; 17. Cabinet . Art joinery and parquetry; 19. Decorative and marble work; 20. Travelling and miscel- objects: 21. Artificial flowers; 22. Usual ns of the arts of drawing and wood-cutting, mechanical drawings, lithography, chromo- hy, engraving, photography and phototypy; -paper, including imitation leathers, writing d office requisites; 24. Clocks, watches, chro- , pedometers, clepsydræ and sand-glasses; mens of typography, autographic proofs, new d editions, periodical publications, atlasses, art , printing ink and accessories; and 26. The achines employed in the above classes.

mmissioner is M. B. F. Pasquier, engineer; and nistrative Council comprise MM. Felix Tasson, Janssens, H. Weber, Alfred Brasseur, and Vasher; the engineer is M. Th. Devadder, ngineer of the Belgian State Railways, who he buildings at the Exposition d'Hygiene in :ther information may be obtained from, and hould be addressed to, the General Manager, de Bavay, Palais du Midi, Brussels.

objects in the Exhibition, now about to close, tures of industrial, humanitarian, or sanitary

esting demonstration of the saving of sub- ch have hitherto been allowed to pass away afforded by a collection shown by the Société es Produits du Flénu, Belgium, of the sub- btained in their process of coke making. ome excellent specimens of tar, ammoniacal zole, benzine, various light oils, heavy oils ng timber, naphthaline, anthracène, pitch, onia, &c.

bition contains some new applications of iron, ht and cast. The Compagnie des Forges ow some hexagonal pavings, which they make out sheet iron into moulds, giving them a d at the same time a deep flange, so as to to keep their place when imbedded in sand. l Gilquart, of Labuissière, shows a similar for roofing purposes. He presses out the nto the form of roofing tiles for overlapping ; and some of them are provided with a of glass. A new industry has lately sprung um, that of enamelled wrought-iron ware for crockery; it has the disadvantage, however, causes the enamel to fly off at the spot where has struck. The Société des Fonderies et , show a case containing representative f the new ware, which is ornamented erns like earthenware, from which it ly be distinguished by sight. M. Per- Geneva, exhibits some paving-blocks con- hollow cast-iron shell filled with concrete, me tramway chairs made in the same manner. e latter have been taken up after service, and to show the fracture. The same inventor his system of insulating underground tele- s. He makes small cylinders of enamelled re, pierced with holes in the direction of their The wires pass through these holes, and the are protected and kept in place by lengths of abes, divided longitudinally and horizontally laying.

nethod of reproducing industrial drawings, aid to be greatly superior to the prussiate of lues" that have lately become common on the is exhibited by M. Ad. Joltran, of Paris. are produced by the aid of the sun acting on *mmo-ferrique*;" and the lines appear of an on a white ground, with all the clearness of ls.

, one-tenth real size, is shown of some tem- rds which have been put up for cases of infectious diseases at the Hôtel Dieu, Châtelet, designed by Dr. Gallez. They are isolated by a system of passage, the two sides of which are closed by framework, but can be left open, if desired, so as to allow the free access of air. The framework is of 1-inch pitch-pine, varnished, and made double, so as to enclose spent tan, saturated with a solution of sulphate of iron, for preventing any danger of infection to other patients. The wards are warmed by the ventilating stove of the Société, H. J. Piron et Cie, of Hodimont Verviers, which produces an active ingress of fresh air, and is so constructed, that the warmed air does not come in contact with the furnace. Mr. F. V. Mouly, of Brussels, shows his "Calorifère atmosphérique et hydrothérapique," which permits of simultaneously warming and ventilating an inhabited building, a green-house, and a place of public *réunion*, while supplying hot water for the baths and lavatories. The heating surface warms the air, combined with water for hygienic considerations; but the flues, uniting in a single chimney, also contribute to warm the building and draw off vitiated air, being surmounted by a special aspirator. Mr. E. G. Banner was awarded a gold medal for his ventilators, some new forms of which are exhibited; while it was practically demonstrated that the wind, blowing with average velocity through a one inch-cowl, is capable of drawing foul air through 72 feet of one-inch india-rubber tubing.

M. Systermans contributes a full-sized section of railway carriage filled with his safety appliances for the protection of the guards when passing from carriage to carriage. A belt, passed round the guard's waist, is attached by a swivelling spring catch to a ferule, which slides along a continuous handrail, attached to the off-side of the carriage. The ferule is so arranged as to clear the fastenings of the hand-rails, which are connected from carriage to carriage by a jointed rod, so as to afford uninterrupted communication. Mr. W. Brenton, of St. Germans, received a silver medal for his safety door and window fastenings; he also shows some traction springs, made by Messrs. Fairholme and Co., of London, for facilitating the start of tram-cars, railway trucks, and other heavy vehicles drawn by horses.

The engine driving the machinery in motion is supplied with steam by a system of safety boiler, which was designed by M. De Nayer, papermaker, of Willebrock, for his own use, but is now becoming generally used in Belgium. The boiler is composed of tubes, in which the steam is generated, connected by wrought or malleable iron receivers. Two tubes form an "element;" and these are in turn connected by short tubes with conical joints, perfectly tight, without any cement or packing. The small diameter of the tubes, and the great strength of the materials employed, render this boiler practically inexplosive; but if, through any unforseen defect in the metal, a tube should give way, the explosion would be confined to that tube, and produce none of those disastrous effects attending the bursting of ordinary shell boilers. The evaporation is from eight to nine pounds of water per pound of small coal. M. J. Barbe, of Brussels, exhibits his additional safety valve, which he applies to the under-side of ordinary boilers for preventing explosions. Messrs. A. H. Bateman and Co., of East Greenwich, who were awarded a bronze medal, show, among other objects, their safety boiler fittings, consisting of—(1.) A new safety valve, in which three spiral springs are substituted for a single large one; a lever is added for raising the valve off its seat from time to time, to make sure that it has not set fast, and when once adjusted to the required pressure the engineman cannot alter it, although the working parts are perfectly visible. (2.) A new water-guage, in which, on the glass breaking, all escape from the boiler is at once prevented, thus obviating the danger of scalding so common on locomotives. (3.) An improved steam sentinel, which gives warning, by whistle, of an excess of pressure, having a lever added to prevent the valve

from remaining fast on its seat. (4.) An improved conical form of fusible plug, for preventing explosions, owing to deficiency of water.

Life-saving on the water was represented by Messrs. C. W. Meiter, of London, with Colonel de la Sala's folding boats and rafts; and M. Verhaaren Rowet showed his safety air-tight cans for holding volatile and inflammable substances.

FAURE'S SECONDARY BATTERY.

Considerable interest has lately been aroused by the announcement that a Paris electrician has discovered a new method of storing electricity. The invention is really a new secondary battery, or, rather, an improvement on the well-known secondary battery of M. Planté. A secondary battery, it is hardly needful to say, is one which is charged by the action of a battery, or machine, and then gives out this charge as required.

In the Planté battery the electrodes are of lead, and they are immersed in acidulated water.

In M. Faure's battery the two lead plates of the couple are each covered with minium (red lead) or another insoluble oxide of lead, then enclosed in felt, kept in place by lead rivets. These two electrodes are then put side by side in a vessel of acidulated water. If they are very long, they are rolled up like those of M. Planté. Thus constructed, the couple is charged by causing an electric current to traverse it, when the red lead is reduced to the state of peroxide on the positive electrode and lead upon the negative electrode. When the whole mass has been thus electrolysed the couple is ready for discharging. On being discharged again, the reduced lead is oxidised, and the peroxide is reduced until the couple becomes inert. It is then ready for a new charge of electricity.

It is stated that a quantity of energy can be stored capable of performing a horse-power of external work during an hour in a Faure battery of 75 kilograms in weight.

A correspondent of the *Times*, "F.L.R.S." has since given an account of a meeting of the Société d'Encouragement pour l'Industrie in Paris, presided over by Mons. J. B. Dumas, at which Mons. Faure's battery was exhibited, and the following somewhat enthusiastic description of a box containing four batteries, which was taken by the writer from Paris to Glasgow:—

On Monday, 9th inst., in Paris, a Faure battery, or *pile secondaire*, was charged with the electric fluid direct from the ordinary Grove battery, and in my presence. In may be more economically done from a Gramme or Siemens machine. The receptacle consisted of four Faure batteries, each about 5 in. diameter and 10 in. high, forming a cylindrical leaden vessel, and containing alternate sheets of metallic lead and minium wrapped in felt and rolled into a spiral, wetted with acidulated water, and the whole placed in a square wooden box, measuring about one cubic foot, and weighing some 75 lb. This was protected by a loose wooden cover, through which the electrodes (in lead) protruded, and were flattened down for convenience of transport. This box of "electric energy" was handed to me by M. Faure, at my request, with the object of submitting it for examination and measurement to our eminent electrician, Sir William Thomson, F.R.S., at the University of Glasgow. I had the box by me all through the journey from Paris on Tuesday night, including a five hours' delay at Calais. I arrived at Charing-cross at 11 a.m. on Wednesday, after running the gauntlet of customs and police authorities, who suspiciously looked askance, and seemed to doubt my statement that my box only held "condensed lightning," and contained no infernal machine or new explosive destined to illustrate some diabolical socialistic tragedy. From time to time on the journey I tested the force of the discharge, and found it to have well maintained its energy. From London to Glasgow required only another 10 hours, and finally, hours from the time of charging in Pari satisfaction of presenting to Sir William T Faure's rare offering of a "box of electri and potent, holding by measurement withi space of one cubic foot, a power equivalen one million of foot pounds! This wonderfu deposited in the laboratory of the Glasgow under the vigilant eye of its director, and mitted to a series of tests and measurement

TASAR SERICICULTURE IN I

The following report from Major Coussma forwarded by the Secretary of State for Ind cation in the *Journal* of the Society:—

Camp Rajur, Ta'luka Akola, 6th

SIR,—I have the honour of acknowledgin (No. 659) of the 23rd ultimo, with its acco and beg herewith to submit, for the inf Government, my report upon the progress in tasar sericulture during the last year.

2. I must first state that, though I have r in gathering a crop of cocoons of my ow have yet gained so much more experience o ledge of the difficulties in the way that I b eventually be able to overcome them withou the expense of the cultivation.

3. My failures last monsoon were owing perfect construction of the cages in which I the worms. These were at first entirely m screens of split bamboo, and served the pur ing out rats, mice, birds, squirrels, and being dark, the plants did not thrive well, a were always striving to escape. I then alt struction, made them longer and put nettin instead of pieces of screen, and here every well for a time, until some wasps and managed to get in and puncture the silk the effects of which the majority died, a lived to spin their cocoons. I shall try t this next monsoon with coarse open cotton will, I expect, turn out to be cheaper than

4. The small plantation which I have thriving, and will, eventually, be able to su siderable number of worms, but I have ha plan to a certain extent. I adhere to my or tion of keeping the plants well pruned, letting them grow more than three or fou but in order to make the junctions of the s secure and vermin proof, I must have t banks seven feet wide instead of four. I h moved to other ground all the other plants "Lagerstramia Indica" (*Gul Mendhi* or the "Zizyphus Jujuba" (*Bher* or *Bhori*), the two kinds which thrive best with me, now five hundred feet of the former and th of the latter available for feeding purpo several cuttings and seedlings which are co

5. My collection of cleaned, perforated c for the manufacture, now amounts to ab weighing about 60 lbs., and sewn up in ba state they will remain without deteriora indefinite period. Of this amount the For ment, working under Mr. Shuttleworth's i contributed this season about 17,000, wh mainder consist of those which I have col other sources, or carried forward from last propose to wait till I have got 1 cwt. before steps towards disposing of this material, a facturer would care to purchase a small amo

6. One of the most promising facts in conn tasar sericulture is the effort which is bein Mr. George Baird with the encouragem Máhárája to establish a plantation at Oodey

st advanced students in Mr. Baird's school oons by the direction of the Máhárája, and ny house daily for some weeks, watching the :he insects, and taking copious notes, which ɔe, bear fruit some day.

ɔt up my usual correspondence with individuals in the scheme, and distributed eggs to them ɪar, Khándesh, Coorg, Rangoon, Ceylon, and

ɪg to changes among the members of the partment, I have not yet been able to get all ɪts settled, but as far as I can tell, I shall nded about Rs. 220 of the 500 placed at my y Government last year, of which about Rs. 45 been paid to villagers for cocoons, Rs. 10 on ɪnd the remainder on laying out and maintain-ɪlantation, in tending the silkworms, and in cocoons for storage.—I have the honour to

G. COUSSMAKER, Major.

BRITISH ASSOCIATION.

lowing arrangements have been made for the meeting of the British Association, to be held —The first general meeting will be held on ɪy, August 31, at 8 p.m. precisely, when A. y, F.R.S., V.P.G.S., will resign the chair, ɔhn Lubbock, Bart., M.P., F.R.S., President-ll assume the presidency, and deliver an On Thursday evening, September 1, at 8 *irée*; on Friday evening, September 2, at 8.30 iscourse by Professor T. H. Huxley, LL.D., on Monday evening, September 5, at 8.30 scourse by W. Spottiswoode, D.C.L., LL.D., of the Royal Society; on Tuesday evening, · 6, at 8 p.m., a *soirée*; on Wednesday, · 7, the concluding general meeting will be 30 p.m. No report, paper, or abstract can be ɪ the Report of the Association, unless it is efore the conclusion of the meeting. Excur-places of interest in the neighbourhood of be made on the afternoon of Saturday, · 3, and on Thursday, September 8.

ɪeral officers are—General Secretaries: Capt. ɪalton, C.B., D.C.L., F.R.S.; Philip Lutley ʼh.D., F.R.S. Acting Secretary: George ɪ.A., F.C.S., Harrow; General Treasurer: W. Williamson, F.R.S. Local Secretaries: nas Adams, M.A.; Tempest Anderson, M.D., ɔrk. Local Treasurer: W. W. Wilberforce,

tions are arranged as follows:—

hematical and Physical Science.—President: William Thomson, F.R.S. Secretaries: Prof. yrton; Oliver J. Lodge, D.Sc.; and Donald ·, B.A., B.Sc. (Recorder).

mical Science. — President: Prof. A. W. ɔn, For. Sec. R.S., V.P.C.S. Secretaries: ·. Dixon, M.A., and P. Phillips-Bedson, D.Sc. r).

ogy.—President: Andrew Crombie Ramsay, F.R.S. Secretaries: W. Topley, F.G.S. r) and W. Whitaker, F.G.S.

logy.—President: Richard Owen, C.B., F.R.S. es: G. W. Bloxam, M.A., F.L.S.; W. L. W. A. Forbes, F.Z.S.; Professor M'Nab, ohn Priestley; and Howard Saunders, F.L.S., *Department of Zoology and Botany.*—Richard ɪ.B., F.R.S. (President), will preside. Secre-rofessor M'Nab, M.D. (Recorder), and Howard ɪ, F.L.S., F.Z.S. *Department of Anthropology.* sor W. H. Flower, F.R.S. (Vice-President), ide. Secretaries: G. W. Bloxam, M.A., F.L.S. r), and W. L. Distant. *Department of Anatomy siology.*—Professor J. S. Burdon Sanderson, F.R.S. (Vice-President), will preside. Secretaries: John Priestley (Recorder), and W. A. Forbes, F.Z.S.

E. *Geography.* — President: Sir J. D. Hooker, K.C.S.I., C.B., F.R.S. Secretaries: H. W. Bates, Assist.-Sec. R.G.S, F.L.S., and E. C. Rye, Librarian R.G.S., F.Z.S. (Recorder).

F. *Economic Science and Statistics.*—President: The Right Hon. M. E. Grant Duff, M.P., F.R.S. Secretaries: Constantine Molloy (Recorder), and J. F. Moss.

G. *Mechanical Science.*—President: Sir W. G. Armstrong, C.B., F.R.S. Secretaries: A. T. Atchison, M.A. (Recorder), and H. Trueman Wood, B.A.

Tickets for the meeting may be obtained of the Local Secretaries at York, and at the office of the Association, 22, Albemarle-street, London, W.; or on application by letter, from August 17 to August 24, to the General Treasurer, Professor A. W. Willamson, British Association, University College, London, W.C.

QUEBRACHO WOOD.

Mons. F. Rhem has lately communicated a paper on the "Quebracho Wood" to the *Société Industrielle du Rouen*, from which the following particulars are extracted:—This wood belongs to the family of the Asclépiades, and comes from America. Being very hard, and composed of a great quantity of interlaced fibres, the tannin it contains is different from that of chestnut or of oak. Gelatine precipitates this tannin out of a water solution with a flesh colour, while salts of protoxide of iron give an ash-grey precipitate, and the peroxyde salts a dirty greenish colouration. When boiled with weak sulphuric acid, the tannin is not converted into gallic acid. According to a German chemist, quebracho wood contains 18 per cent. of tannic acid. The back of this wood contains an alkaloid analogous to quinine. Extract of quebracho, now much used in wool dyeing, giving a yellow shade with a tin solution. It gives even shades, resembling those of cutch, if used with bichromate of potash, but its principal use is for obtaining blacks, for which the wool is given first a bottom of the extract, then passed through iron, and dyed with the quebracho; this, in these conditions, can replace cutch. Solutions of quebracho wood, or extract, will only keep limpid if heated to a certain temperature, but get turbid on cooling. Dyeing experiments, with the dry quebracho extract, as manufactured by a French firm, in comparison with cutch, have proved the former of more value, since, with a lower price, it possesses a greater richness of colouring matter. Three series of trials were made: one, by passing the cotton prepared in a quebracho or cachou bath through bichromate of potash; the second, through iron; and, in the third, the patterns were passed through iron and then chromed. In all cases the same results were obtained, showing the advantage of the quebracho over cutch, in spite of a slightly more greyish shade of the colours obtained with the former. The same results have been got by printing mordants on calico, ageing, dunging, and dyeing with quebracho extract or cutch; in all cases the quebracho shades being identical with those of cutch, not only for the tone of colour, but also in regard to fastness.

GENERAL NOTES.

Ladies' Sanitary Association.—At the meeting of this association, held last week, on the occasion of the distribution of prizes by H.R.H. Princess Christian, of Schleswig-Holstein (see *Journal*, p. 552), Sir Henry Cole, in replying to a vote of thanks passed to the Society of Arts for the use of the hall, said it was the business of that Society to do what other people—Government especially—did not do, and to show the Government a better way of doing things. At

present the Society was engaged in a most interesting work. Ladies were doubtless aware that in this country the system of teaching needlework was confined to senior wranglers. Now this Society was trying to induce ladies to conduct a course of instruction in domestic economy, including the teaching of needlework, the making of clothing, cooking, and other arts in which woman shone pre-eminent, but the teaching of which, by accident, had got into the hands of men.

Suez Canal.—In the course of 1880, 2,017 ships passed through the canal with a tonnage, according to official reckoning, of 2,860,448, but really amounting to 4,378,964. The number of hands employed in the navigation was 128,453; the number of passengers, 53,517. Of the 2,860,448 tons official reckoning, 2,247,306 were British, 177,771 French, 75,820 Austrian, 124,083 Dutch, 71,039 Italian, 56,245 Spanish, 38,162 German, 29,607 Russian, 7,203 Turkish, and 8,032 Egyptian, while 25,180 tons belonged to other States.

Total Production of Coffee.—According to the Batavian *Journal of Agriculture*, the production of coffee by the whole world, in 1855, was 330,152 tons, and, in 1878, no less than 490,843 tons, showing an increase during the 23 years of 160,675 tons. These quantities were yielded by the following countries:—

	1855.			1878.	
Brazil	163,400	tons.	..	225,500	tons.
Dutch Indies	71,322	,,	..	91,405	,,
West Indies	29,300	,,	..	41,800	,,
British India and Ceylon	28,780	,,	..	53,422	,,
South Africa	22,315	,,	..	35,890	,,
Arabia	6,176	,,	..	2,779	,,
Africa	4,000	,,	..	4,000	,,
Central America	3,500	,,	..	32,500	,,
Philippine Islands	1,359	,,	..	3,397	,,
Oceania	—	,,	..	150	,,
	330,152			490,843	

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock:—

MAY 25.—Adjourned Discussion on Mr. ALEXANDER SIEMENS'S paper on "The Electrical Railway, and the Transmission of Power by Electricity."

FOREIGN AND COLONIAL SECTION.

Tuesday evenings, at eight o'clock:—

MAY 31.—"The Principality of Loo Choo." By Consul JOHN A. GUBBINS.

CANTOR LECTURES.

Monday evenings, at eight o'clock:—

The Fifth Course will be on "Colour Blindness and its Influence upon Various Industries," by R. BRUDENELL CARTER, F.R.C.S. Three Lectures.

LECTURE II.—MONDAY, MAY 23.

Mistakes of the colour-blind in daily life. Their methods of endeavouring to counteract the consequences of their defect. Modes of testing for colour blindness. Sources of error in testing. The actual prevalence of the affection in this and other countries, and in different classes of the population.

LECTURE III.—MONDAY, MAY 30.

Industries chiefly affected by colour blindness—Engine-drivers, pilots, artists, letter-sorters, drapers, painters, &c., &c. Recent legislation affecting colour blindness in America, and urgent need for it in this country. Conclusion.

MR SHELFORD BIDWELL'S PAPER.

In consequence of Mr. Bidwell's severe indisposition, he has been unable to prepare his paper on "Telegraphic Photography," announced to be read before the Applied Chemistry ar Section on Thursday, May 26th, and th has, therefore, been unavoidable postpon

INDIAN SECTION.

Sir Arthur Phayre's paper on "Burn the discussion, will be printed in ne *Journal.*

MEETINGS FOR THE ENSUING WE

MONDAY, MAY 23RD...SOCIETY OF ARTS, J Adelphi, W.C., 8 p.m. (Cantor Lectur Brudenell Carter, "Colour Blindness, and upon Various Industries." (Lecture II.)

National Indian Association, 11, Chandos- 8½ p.m. Mr. C. N. Banerjee, "Home Ec Indian Ladies."

Royal Geographical, University of London, gardens, W., 2 p.m. Annual Meeting.

British Architects, 9, Conduit-street, W., 8 p tribution of Medals and Prizes. 2. Prof. "Some Observations on the Mariette Ex Sakkara, in reference to Discoveries re there."

Geologists' Association, University College, V sion to Sheppey.

TUESDAY, MAY 24TH...Royal Institution, Albemarle 3 p.m. Prof. Dewar, "The Non-Metallic (Lecture V.)

Medical and Chirurgical, 53, Berners-stre street, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Mr. John I. T Paper, "Torpedo Boats and Light Yacht Speed Steam Navigation." 2. Mr. Ric Brunton, "The Production of Paraffin Oil."

Anthropological Institute, 4, St. Martin's- 8 p.m. Dr. Allen Thomson, "Some Bo from the Andaman Islands. 2. Mr. E. H. Arts of the Andamanese and Nicobarese." Walhouse, "Some Vestiges of Girl Sacrifice and Contracted Interments in India and th

Royal Horticultural, South Kensington, S.W

WEDNESDAY, MAY 25TH...SOCIETY OF ARTS, Adelphi, W.C., 8 p.m. Adjourned Discu Alexander Siemens's paper, "The Electri and the Transmission of Power by Electric

Geological, Burlington-house, W., 8 p.m. Hicks, with an appendix by Mr. R. Eth Discovery of some Remains of Plants at the Denbighshire Grits, near Corwen, N 2. Mr. Edgar Willett, "Notes on a Man from the Purbeck Beds at Swanage, Dorse H. G. Seeley, "The Reptile Fauna of the mation."

Royal Society of Literature, 4, St. Martin's 8 p.m. Mr. C. Pfoundes, "The Popular Old Japan."

Telegraph Engineers and Electricians, 4, Th Westminster, S.W., 8 p.m. Mr. P. V. Construction and Working of a Military graph, based upon Experience gained dur paigns in Afghanistan in 1878-79-80."

National Education Union, Westminster I S.W., 2½ p.m. Annual Meeting.

Ascham Society, 18, Baker-street, W.

Royal Botanic, Inner-circle, Regent's-park, Summer Exhibition.

THURSDAY, MAY 26TH...Linnean, Burlington-house, Anniversary Meeting and President's Addr

Royal Institution, Albemarle-street, W., 3 Tyndall, "Paramagnetism and Diamagnet ture V.)

Inventors' Institute, 4, St. Martin's-place, Annual Meeting.

FRIDAY, MAY. 27TH....Royal United Service Institute yard, 3 p.m. Major-General D. J. Newal Colonisation as a Reserve for India."

Royal Institution, Albemarle-street, W., 8 p. Meeting. 9 p.m. Prof. H. E. Roscoe, "A duction of Indigo."

Quekett Microsc pical Club, University Co 8 p.m.

Clinical, 53, Berners-street, W., 8½ p.m.

National Health Society, 23, Hertford-street, (Drawing-room Lectures.) Mr. Ernest Ha Progress in Health Knowledge."

SATURDAY, MAY 28TH . Physical, Science Schools, Sou ton, S.W., 3 p.m.

Royal Institution, Albemarle-street, W., 3 p. E. Turner, "Russian Literature." (Lectu montoff.

OF THE SOCIETY OF ARTS.

No. 1,488. VOL. XXIX.

'RIDAY, MAY 27, 1881.

ms for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

CONVERSAZIONE.

ty's *Conversazione* is fixed to take place ı Kensington Museum (by permission ls of the Committee of Council on on Thursday, the 2nd June.

ıade Concert will be given by the String Royal Engineers, in the North Court. ›rney Grain will give Three short ›nts in the Lecture Theatre. Madame will give a Pianoforte Recital in the ery.

ries containing the Raphael Cartoons, anks Collection, the Wm. Smith Collecter Colour Drawings, the Dyce and tures, the Collection of Paintings lent tees of the late Rev. Pryce Owen, and trey Bequest," will be open.

ts and Corridors of the Ground Floors ı.

ption will be held in the Architectural :r. F. J. BRAMWELL, F.R.S., Chairman, Iembers of the Council.

s of invitation have been issued to

CANTOR LECTURES.

nd lecture of the fifth Course, on lindness and its Influence upon Various ' was delivered by R. BRUDENELL '.R.C.S., on Monday, 23rd inst. The lated some of the mistakes of the d in daily life, and their methods of ng to counteract the consequences of . He described the modes of testing blindness, and the sources of error in des which have been adopted. Prof. s test, by means of skeins of coloured as explained and illustrated, and the acluded with statistics of the actual of colour blindness in this and other countries, and in different classes of the population.

The lectures will be printed in the *Journal* during the autumn recess.

ART FURNITURE EXHIBITION.

The Exhibition of Works of Art Applied to Furniture, in connection with the Exhibition of Fine Arts at the Royal Albert Hall, was opened on Saturday, 21st inst. A non-tranferable season ticket will be sent to any member of the Society on application to the Secretary.

PRACTICAL EXAMINATION IN VOCAL OR INSTRUMENTAL MUSIC.

The next Examination in London will be held by Dr. Hullah, the Society's Examiner, at the House of the Society of Arts, 18, John-street, Adelphi, W.C., during the week commencing on the 4th July, 1881.

HONOURS.

The Examination in Honours will consist of three sections, viz., a paper to be worked, an examination similar in form to the practical examination for a First and Second-class, and a *viva-voce* examination.

FIRST AND SECOND-CLASS.

Vocal.

Candidates for a First or Second-class Certificate in Vocal Music will be required—

[1.] To sing a solo, or to take part with another candidate in a duet, already studied.

[2.] A key-note being sounded and named by the Examiner, the candidate to name sounds or intervals, or successions of sounds or intervals, played or sung by the Examiner.

[3.] To sing or sol-fa at sight passages selected generally from classical music.

Instrumental.

Candidates for a First or Second-class Certificate in Instrumental Music will be required—

[1.] To play a short piece, or a portion of a larger work, already studied.

[2.] A key-note being sounded and named by the Examiner, the candidate to name sounds or intervals, played by the Examiner.

[3.] To play a piece or portion of a piece at sight.

The examination of each candidate will be private; no one but the Examiner and the accompanyist being present, unless it be a member of the Society of Arts' Committee.

No list of Candidates will be published.

Full particulars can be obtained on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

Friday, May 13th, 1881; Sir RUTHERFORD ALCOCK, K.C.B., in the chair.

The paper read was—

BRITISH BURMA.

By General Sir Arthur Phayre, G.C.M.G., K.C.S.I., C.B.

The province of British Burma, by the rapid progress that it has made in material prosperity during the last twenty years, has attracted the attention of all who are interested in the empire of India. In submitting to this Society a brief account of the present condition of that country, it is necessary to state that statistics of trade and revenue are not available for a later period than 1879-80, but the population by the census of this year has just been received, and that for the purpose of illustration of the comparative progress of the province, it is not proposed to do more than briefly refer to some of the statistics for a few years preceding that above mentioned.

It is scarcely necessary to remind you that the country called Burma, that which is inhabited mainly by people of the Burmese race, and which is as distinctively the country of the Irawadi and its tributaries as Egypt is the gift of the Nile, is divided politically into two parts: British Burma, and Independent Burma. It is proposed on the present occasion to deal principally with the former, and to refer only incidentally to the latter.

British Burma was formed, to speak generally, from the union of three maritime provinces, two of which, Arakan and Tenasserim, were annexed to the British Indian Empire in 1826, and one, Pegu, which became British territory in 1852. The province has a direct sea coast line extending about nine hundred miles along the eastern shore of the bay of Bengal. Though for such an extent the number of ports is limited, yet the outlets of the great rivers give at Akyab, Bassein, Rangoon, and Moulmein, admirable positions for trade with other countries. The province has an area of about 94,000 square miles, being a little larger than Great Britain.

The Burmese people who, including the Talaings or Peguans, form about five-sixths of the population of British Burma, are classed by ethnologists as Mongoloids. The numerous hill tribes, Karens, Khyengs, Kamis, and others, belong to the same family. The Burmese, by their physiognomy as well as by their language, show that they belong to the same family as the Bhote, or people of Tibet. The connection from the one to the other, though their countries are so far apart, may be traced by similarity in the physical form, and speech of tribes dwelling on the south-eastern border of the great plateau of Tibet, and bordering the way along the courses of rivers to the country of the middle Irawadi. The Burmese language may be roughly described as monosyllabic, though this classification can only be applied to it with considerable modification. The Talaing people, who chiefly inhabit the the Irawadi, may, no doubt, be trace same original seat as the Burmese; b ancestors appear to have left it at a mu period than the forefathers of the latte language, which now differs materially fro the Burmese, has become nearly extinct, is, perhaps, a larger Talaing-speaking Siam than in Pegu. The total popu British Burma, by the census of this year, to 3,704,253 souls. In order to show increase in population which has taken may now be stated that, in 1855-6, the amounted to 1,252,555 souls. Probably t may then have been under-stated from returns; but even supposing that the reached to so much as a quarter of a millio one-fourth of the whole, the fact will rem in a quarter of a century, the population ha trebled. This, no doubt, has resulted from immigration from Upper Burma, people are also increasing from natural cau sequent on freedom for their industry, the of war, and, it is believed, generally i sanitary condition from better food and cl

The amount of imperial revenue—tha including what is collected by municipal raised from this population amounted, in in round numbers to £2,100,000. That greater proportional amount than is paid other province under the Government of I may, at the same time, be noted that the collected in 1855-56 was, in round £531,792. While, therefore, in twenty- the population has nearly trebled, the rev nearly quadrupled. This great increas assured, has resulted from general inc prosperity, and not from excessive tax may add that the only item on which I w to see a reduction in the annual revenue i arising from the consumption of opiu quantity consumed might be very much by Governmental action with great adva the community, and I learn within the last that measures have been adopted for that

In considering the question of progre prosperity of British Burma, nothing instructive than the continued regular in the area of cultivated land. By most important agricultural product It may almost be considered the o cultural product of British Burma, so m it exceed in quantity all others. Thi from the soil and climate being very su that cereal, and to the people thoroughl standing the method of cultivation required the native Government, rice was not all be exported by sea, from the notion that sary an article of food should be kept in the as a reserve in case of famine. Conseque more was produced than was required f consumption. After the country became and sale of produce was unrestricted, the at once extended their cultivation. The re be seen in the following figures. In 1855 total area of cultivated land paying rev Government was 1,075,374 acres. In 1879 area was 3,364.726 acres. The value of ported by sea was, in 1855-6, £1,482,475; 1879-80, £5,274,311.

Burma is owned by small proprietors.
f property in the soil is independent of
ng power, and is so laid down in the
criptures. The average area of each
which rice is raised, is not more than
ht acres. That is the area available
ion. Grazing land is that which is left
each village, and is common to the
thereof. All owners exercise the right
ise, gift, and mortgage, though sale
very seldom made. There appears to
ction to it which may almost be called
respective of the rights of heirs, which
ienated, and when land is sold by deed,
illy expressed that the object of the
to build a pagoda or other religious
eon. This is supposed to justify the
land is occasionally let from year to
rbal engagement, the tenant agreeing
per cent. of the produce.
lopment of commerce in British Burma
ce with the increase of population and
The export of rice has already been
nnection with the extension of cultiva-
trade of the province may be classed as
ried on by sea with foreign countries,
ritish India; and (2) that carried on by
ation, or by inland caravan traffic with
t Burma, China, and Siam.
increase in the sea-borne trade will be
a comparison of figures for 1879-80,
for 1871-72. For both years all imports
of goods on account of the Government
xcluded.

1871-72.—*Imports and Exports.*

merchandise	£6,938,202
....	1,311,356
Total..........	8,249,558

879-80.—*Imports and Exports.*

merchandise	£12,348,373
....	3,206,939
Total..........	15,555,312

ot be necessary to do more than mention
l articles. The two of most import-
United Kingdom are the cotton and
goods, the cotton twist and yarn of
nufacture. The value of those goods
n the year 1871-72, amounted to
and woollen goods to £88,372. In
he value of the former amounted
153; and woollen manufactures to
When I say these were of British
e, it should be noted that, strictly
7 per cent. of the goods were shipped
United Kingdom. Considering the
of British Burma small in comparison
f most provinces in British India, this
arge proportional amount of annual
n. Of the quantity of such goods
applied to people in the interior, in
yond the British frontier, I will speak
e to notice the inland trade.
rts from British Burma by sea consist
of rice, the value of which has already
. for one year. The next article in
is teak timber, which is probably the
ole wood known for ship-building and industrial purposes. There has been a considerable falling off in the export of teak timber within the last five years. In 1875-76, the value exported amounted to £432,389, and in 1879-80, to only £273,967.

Teak timber exported is grown both in British territory and beyond it. The teak forests in British Burma are the property of Government, and are carefully conserved. No care appears to be taken of those in Independent Burma, or in Siam, and it is to be feared that the destruction now going on must in a few years render it impossible to find large-sized timber in those countries, in such positions as to be available for the market. In the districts of British Burma, which were annexed in 1826, similar waste was allowed. It was only in 1852, when experience had shown the absolute necessity of guarding against indiscriminate felling of trees, that the Marquis of Dalhousie issued orders for the formation of a forest department in the province. First under Dr. McClelland, and afterwards under the present Inspector-General of Forests in India, Dr. Brandis, successful measures were adopted, for the conservancy of forests. This it was which led to the formation of a Forest Department for all India, which it is now acknowledged has been of vast benefit to the empire.

The growth of teak trees in British Burma is secured partly by planting in suitable localities, and by guarding against destructive agencies all young trees whether planted or of natural growth. The principal destructive agencies are:—Fire, which in the dry season, unless prevented, frequently spreads over hundreds of square miles, and kills young trees; parasitical plants; and the method of clearing ground for cultivation on mountain slopes carried on by the hill tribes, who indiscriminately fell trees and burn them in one mass. The latter enemy to forest conservancy is, perhaps, the most difficult to deal with, as there is great danger of exciting the ill will of the hill tribes by interference with what they have from time immemorial considered their right. Great caution therefore is necessary, and has been observed in carrying out measures necessary to check the destruction of trees by that means. Teak trees which have arrived at maturity, that is at the age of eighty to ninety years, are girdled two or three years before they are intended to be felled. The rise of the sap being thus intercepted, the trees die, and they become thoroughly seasoned while still standing. They are then capable of being floated down the streams and rivers without delay after having been felled. During the last five years there has been a material decrease in the yield of teak timber in the forests of British Burma. This will be seen from the following table of the actual quantity brought down during each year:—

	Tons.
1875-76	46,597
1876-77	46,431
1877-78	39,081
1878-79	22,763
1879-80	17,585

It must not be supposed that the diminution in the annual supply brought to market indicates a diminution in the actual number of mature, or full-sized teak trees existing in the forests. The reduction proceeds from various causes, and it may

be confidently pronounced that the effect of the forest conservancy in British Burma has been to render available for public use a valuable natural product, while guarding against wasteful felling, which would, in a course of years, extinguish the supply for future generations. Various other timber trees are cared for in the forests of Burma, which is not necessary to enumerate. Cinchona trees have been planted, but the result, as yet, has not been favourable.

As regards the teak timber floated down the rivers into British Burma from the neighbouring countries, it will suffice to observe that the quantity is about four times that derived from forests in British territory. But, as already stated, as no conservancy is exercised in those countries, the supply, before many years, will probably be much reduced. Other articles exported from Burma are cutch cotton and petroleum, but they do not call for any particular remark. One abundant natural vegetable substance, however, promises to become utilised, and to add to the products exported to other countries. I allude to the manufacture of paper from bamboo fibre, which has been undertaken by Mr. Thomas Routledge. This enterprise will turn to good account a plant which grows rapidly in every part of British Burma; and there are many tracts where plantations of it may be formed for the object in view. The material would be exported in the shape of fibrous paper stock.

The inland trade of British Burma with Independent Burma and the Shan States is only yet in its infancy; but it has made great strides within the last few years. The progress during eleven years has been gradual, and is shown by the following figures:—

1869-70.	
Value of exports	£1,283,588
Value of imports	905,308
Total	2,188,896

1879-80.	
Value of exports	£1,880,052
Value of imports	1,983,354
Total	3,863,406

In order to show the value of the inland trade of British Burma in articles of British manufacture, and its progressive increase in eleven years, the following statement of the value of exports of textile and fibrous fabrics is given:—

	1869-70	1879-80
Cotton piece goods	£44,549	£191,821
Silk piece goods	9,025	168,936
Woollen piece goods	7,941	43,524
Cotton twist and yarn	49,281	157,924
Total	110,796	562,205

The great bulk of the trade with Independent Burma is carried on by the River Irawadi. It is worthy of notice that, notwithstanding the unsatisfactory state of the relations of the British Government with the Court of Mandalay, trade between the two countries has not materially suffered. The great object of establishing and maintaining a direct trade with Yunnan has not been accomplished. The main obstacle to success may be attributed to the Chinese merchants settled in Burma, and to the Chinese local authorities on the border. The opposition of the former arises from jealousy of foreigners, and what e people similarly circumstanced shows, losing a profitable trade. On the Burmese Government has been faith treaty engagements with the Govern of India, and with prudence and av aggressive conduct, which is certainly n arise from the Burmese Government, t reason for doubting that the interest countries, as regards friendship and com be maintained.

Means for ready locomotion and con produce are, of course, directly conne trade and all material progress. When th was first occupied by the British Governm was an entire absence of means for int munication, except by the rivers. In Tenasserim the great annual rainfall c a serious obstacle to the construction an nance of roads, the outlay necessary to abrading force being great, and the prosp turn or benefit in a sparsely-populated remote. In Pegu, the Irawadi has alwa great highway, and in the delta which over ten thousand square miles, hundreds secting navigable creeks form an excellent for movement by vessels of all sizes, from canoe to barges of a hundred or more ton But made roads for wheeled vehicles known. Main lines of metalled road ha the British Government, been constructed to a small extent. The total length of t not exceed five hundred miles. The b village and distinct roads to connect v lines will yet occupy many years. A ra been built from Rangoon to Prome, a d 163 miles. The success of the line after has been greater than could have been an considering the bulky nature of the prod carried, and the nearness of the river to The net earnings by the last account w cent. on the outlay. The chief source appears to be by passenger traffic.

The navigation of the Irawadi by the st the Irawadi Flotilla Company continue rupted, notwithstanding occasional repo friendly relations with Independent B 1879-80 there were made 129 trips up down, between Rangoon and Mandalay. Bamau appears to have been made. connect the Pegu river with the Sitt completes the water highway between and Toungoo, and is a great advantag A railway between the same towns has sanctioned by Government, and will be co at once. The coast of British Burma several ports are well-provided with lig There are seven, and one light vessel.

Among remunerative public works, the ment of the Irawadi takes a prominent p exhaustive report thereon has been ma Robert Gordon, C.E., under whose dir works now are. The object of the em was to protect cultivated and cultivable l inundation. This has to a considerab been effected. But as is to be expected i with a great river, having a rise of ab feet when in flood, and an extreme dis the rainy season, thirty miles above th the delta, of two millions of cubic feet p

omplications have arisen, and the question er embankment is still under considera- the lower part of the delta there are some ds of square miles which can be made le by an embankment, and where the y from the destructive force of current is educed. Mr. Gordon has, with reference eriodical rise of the Irawadi, the rainfall eastern Himalaya, and the discharge of by the rivers entering the Brahmapootra e north, in Assam below Sadiza, concluded e Irawadi is the continuation of the Sanpo et. This is one of the few great questions geography of Asia which has still to be and which has been a subject of contro- ince the time of d'Anville.

aper proposing to treat of British Burma, er cursorily, would be incomplete without notice of the state of education. Elementary edge of reading and writing is more ally diffused among the people of Burma is the case in India, and even in some ries of Europe. This has resulted from the mental principles of Buddhism. For the hists having originally protested against man exclusiveness in matters of religion, and ards the acquisition of knowledge by those de their own body; and having contended for ight of all to rise by personal mérit to iastical and secular eminence, and to inherit her reward by transmigration, the doctrine o a general diffusion of instruction among asses of the people. Hence in Burma all children are taught letters; the national ls are the Buddhist monasteries, and the masters or the directors of the studies e rahâns or monks. There are also in some lay schools, in which both boys and girls are t. The rules of Buddhist monks prevent from teaching girls; but female education is, the higher classes, carried on in families, l as in lay schools. The great importance of ion being directed to the indigenous schools tish Burma will be seen from the number of rs in the monasteries and lay schools, the of which have agreed to receive Government tion. The number is 70,858 boys, and 3,330

hese indigenous schools the medium of in- ion of course is the vernacular language of untry. In the majority of instances the ction does not extend beyond mere reading, g, and arithmetic. In the monasteries there erally very little of the latter, as it is not led as a part of religious knowledge, and is, ore, a hindrance rather than a help to the ss of those who enter the path. The rahâns however, had the good sense to allow this of secular knowledge to be taught in their teries. In the monasteries those boys who tended by their parents should become monks for years, while the great majority leave The object of the Government in connection the monastic schools has been to avoid all rence with the religious teaching, and to the head monk of each monastery to admit tors, in order that the secular studies should re systematically pursued, and the course be advanced than hitherto. For this purpose tary books on arithmetic, geography, and other subjects have been supplied, and are used. The monastic schools are far more numerous than the lay, there being in 1879-80, 2,693 of the former to 355 of the latter. But more difficulty has been formed in bringing the former into connection with the Government, and it is only in the latest report that it is stated—

"The monastic schools have made a remarkable advance, especially in the most important districts. Annual examinations of the monastic and lay schools are held, and prizes awarded. The girls in the lay schools are distinguished for their zeal and aptitude."

The Chief-Commissioner, in his resolution on the results of the year, observes:—

"After some years of only partial success, the Education Department has, mainly through the instrumentality of Burmese inspectors, got the teachers of monastic schools to accept with gladness, which now seems to be heartfelt, the visits, the inspection, and the guidance of our educational officers."

When it is remembered that the object in view necessitated action by Europeans, through native agency, in the denominational schools of an Asiatic people, and made it imperative to convince the heads of those schools of the entire absence of any wish or intention to interfere with, or counteract the religious instruction going on under the same roof to the same pupils, it will be felt that success could only have been attained by a rare union of tact, discretion, and earnest perseverance on the part of those to whom the work was entrusted. For the result, the Education Department of British Burma, under the direction of Mr. Hordern, may well be proud.

Of other educational work, it will only be necessary briefly to observe that numerous schools have been established in British Burma by American, French, and English missionaries. The American Baptist missionaries were the earliest in the field, and have achieved great results among the Karen people. The missionary societies have primary vernacular schools, and also secondary schools, in which the English language is taught. All these receive aid from Government, on account of the secular instruction given. The Government have also second-class schools in each district, while in Rangoon there is a High school, which has lately been affiliated to the Calcutta University. Each year pupils pass the University entrance examination, and some are now reading for the First Arts examination. Considering that the most populous part of Burma, which furnishes the great majoirity of students, has been a British possession for less than thirty years, it may be pronounced that the advance made in sound education has been satisfactory, and is evidence of the capacity of the people, and their desire for improvement.

I have endeavoured, in the time allotted to me, to place before you the several points in the present condition of a people differing in race, in language, and in religion, from the people of India; and I trust that the result will appear favourable to their moral and material progress. It is evident that the country and the people have before them a great future.

DISCUSSION.

Sir Henry Norman, K.C.B., said he had twice visited British Burma, and on each occasion had experienced the

greatest possible interest in doing so. The first occasion was more than 20 years ago. To speak of Burma, was to speak of Sir Arthur Phayre, for the two seemed to be inseparably connected. Sir Arthur Phayre was almost the first British representative in Burma. He started the province, and after many years of good government, left it in a fair way of that progress which had hitherto continued. Certainly, no province in India that he knew of had made such wonderful progress in the last 25 years, and it seemed as if that progress would still go on at the same rate. How much of that was due to Sir Arthur Phayre some of those present knew. It would be very interesting if some of the gentlemen who had spent many years in Burma, whom he saw present, would add to the information which had been given. Up to a recent date almost the only mode of travelling in Burma was by water, and that was accomplished with great comfort, and he hoped with profit to the steamboat company; but, within the last few years, railways had been started. At first there was a good deal of opposition to the project, and fears as to its result, but these doubts seem to have been quite dispelled by the experience already gained. He hoped the railway systems now projected in British Burma would be carried out, and he was quite sure they would be not only profitable to the State, but would conduce to the prosperity and progress of the country.

Mr. E. G. Man desired to thank Sir Arthur Phayre for his excellent paper, which was really exhaustive. He, as an old Anglo-Burman, recognised several gentlemen who had passed many years in the country, but if he might speak for them as well as himself, he should say that every subject had been touched upon in so masterly a manner by one who knew Burma so much better than most of them, that it would be superfluous to add anything. He would only make one remark on one part of the paper, and that was with regard to the statement that there was no communication at present, or were none last year, between Mandalay and Bhamoo. He believed steamers had been running between those places up to the present time. He had also something to do with the timber business there, and could endorse every statement made with regard to the destruction which had taken place amongst the teak forests. Every year the size of teak timber was so decreasing that they had to go farther and farther inland for it; and even in the independent province of Upper Burma, the teak forests had been so worked out that, at the present moment, there was very little about, and in a few years there would not be a tree of any fair size to be got at. Of course, water carriage was of great importance in this respect, to enable them to get the timber down Rangoon, so that the merchants could sell it with any chance of realising a profit. With regard to the question of education, also, he could fully endorse Sir Arthur Phayre's statement respecting the experiments made by Mr. Horden and the Educational Department. There was no doubt that Burma was one of the best educated countries in the East. The people seemed anxious to learn; the monks taught them uncommonly well. He had not the slightest doubt there was a great future before British Burma.

Mr. Wm. Botly desired to make a remark or two on the influence of forestry on the climate and agricultural interests of the country. Only that day he was reading, in the Royal Agricultural Society's *Journal*, just published, a statement that the idea of an international exchange of reports on corn and forestry was first started in 1872, when, in Pesth, resolutions were passed in favour of agricultural meteorology receiving attention. That was brought before the Meteorological Congress at Rome, in 1879; and a Congress was held in September last year in Vienna, which was attended by 22 members, representing meteorology and agriculture of Europe in about equal proportions. Austria sent 8 representatives, France 3, Germany 5, Hungary Denmark, Italy, and Switzerland 1 each. Great Britain were not represented, unfort in our own case, the Meteorological taken the programme of subjects to into careful consideration, and had dr forwarded a series of replies to the vari therein contained. For further inform the result of the Conference, he must refe to the *Journal of the Royal Agricultural Soc* too long to repeat. It showed the great i throughout Europe in this question, and tl no doubt that it was of equal importance i Burma. He was glad that it had received the paper, and hoped the Government wou possibly could to preserve the forests.

Mr. Pfoundes asked if Sir Arthur Ph Burma would be a likely field for research to ancient literature. Perhaps, at some fu might give them further information indigenous literature of the country. So been said about education, but he did not not with regard to old literature. He should l whether it was much affected by the anci or by the more modern Chinese under the I if there were any traces of old Arabic lite believed also there was a wide field in anthropological investigation.

Mr. Thomas Routledge said he was very an opportunity of adding a few remarks interesting and instructive paper, especia greatly desirous of utilising some of the p products of Burma. For nearly thirty y devoted his attention to the utilisation of r paper-making, and during the last six or had devoted himself especially to the ba present in Burma as a valuable paper-mak There were numerous other fibrous genous to that country, which might be cu advantage, but the bamboo received his spec because it grew in almost inexhaustible s many districts occupying many hundred miles, to the exclusion of all other vegeta facility of its treatment was unexampl other fibres, such as the aloe, the plantain (*musa textilis*), &c., required a l of manipulation, and, hitherto, no suitab had been devised for the purpose. Th difficulty in utilising them, because the c sparsely populated, the labour requisite these fibres, which were chiefly suitable could not be obtained. A paper-make pelled, from the exigencies of his trade, with the refuse of these fibres, and he the expense of producing them as textile some years to come, be prohibitive. The the contrary, threw up long shoots every perennially—for 60 or 70 years at least established. All you had to do was to cut pass them into one of those streams wi country abounded, float them down to th them, and convert them into rough "stock' which he produced), and there was the paper-makers were so much in want of. T cost nothing but the collection, and thou lation was sparse, he believed the difficulty over. Of course the population could n impenetrable jungle, but as it became population would follow, provided there tion for them. In a small pamphlet, pu time ago, he drew a parallel between the asparagus, the main difference being that y cut asparagus for five or six weeks, whil season lasted several months. He belie ultimately form a good textile material. made rope of it; the houses they lived

f their vessels, and nearly everything else was bamboo. An important Blue-book had lately l by the Government of India, written by Mr. of the Agricultural Department, giving a the materials suitable for paper-making in s he had said, Burma was exceedingly rich in es, as hemp, flax, jute, and the hibiscus tribe; ese, like the aloe, required to be cultivated, to d dried, then steeped, or retted, and then hand ation was needful to prepare them for the whereas the bamboo required nothing at all. cess the bamboo underwent was simply to crush r stem and boil it, and reduce it to a tow-like on, when it could be compressed like jute or , and it would then come into the ordinary freight- t those articles—about 45 cubic feet to the ton. was done by a process he had patented in India. bamboo, when dried and in its natural con- n was very hard and intractable, and, with any em of simple crushing, could not be brought into a able bulk for freightage, which, after all, was a most ortant point, as affecting the cost of any raw erial. A ton of produce, whatever it might be, ld not occupy more than about 40 cubic feet as dead ght, but the bamboo, crushed to the utmost possible nt, would occupy 96 cubic feet, and if merely led in the ordinary way, even under a pressure of or three tons to the square inch, would occupy 125 c feet, and, therefore, it could not come to this try as a raw material without some previous ment. Treated as he proposed, its cost here d be about the same as the very cheapest rial in the market. He was glad to say that ad received the very warmest support from the n Government, and he was pleased to have this c opportunity of expressing his acknowledgements Chief Commissioner Mr. Bernard, Dr. Brandis nspector-General of Forests, and Mr. Ribbentrop Major Seaton, the Forest Conservators, with whom he een in communication. There were at first some ers, but on the whole they were now coming round s views. He had now a special concession from Indian Government in Burma, having chosen province on account of its very favourable tic conditions, particularly the large amount of all on the coast, which was as much as 160 to 200 s per annum. In some parts there, rain or showers nine months out of the twelve, which was very urable to the rapid growth of the bamboo. rds the north there was not so much rain. soil was a rich loam, and in Arrakan there an abundance of streams, which enabled you at the stuff down to the port. (He produced les of crushed bamboo, "paper stock," "half- ," and also paper made entirely of bamboo.) Arthur Phayre had referred to the enormous ase in the shipments of rice from Burma, and he t mention that the first shipment of 3,000 tons made by his friend Mr. Begbie, in 1855. In 1856, hipments were 50,000 tons; and by 1860, 80,000 while, last year, they exceeded 800,000 tons. ad tried rice straw for paper, but it was too costly, not good enough. For the cultivation of rice rakan they had been compelled to introduce labour Chittagong, but where things would grow to give fit, labour would follow. In the southernmost of the province, he was informed there was an dance of Chinese labour, and he had no doubt if sufficient inducement were offered to those strious people they would make their way into other cts. Jute again showed the same wonderful de- ment as rice. In 1861, the imports did not d 27,000 tons, but last year they exceeded 00 tons. Esparto had developed just in the way. In November, 1856, a paper was read in room by Dr. Royle, and the Society's *Journal*, con- ng the paper, was printed on esparto paper, which he (Mr. Routledge) had then first introduced. In fact, in 1860, he was the only paper-maker using it, whereas now 200,000 tons a year were used. It was now getting very scarce and dear; it had been almost exhausted in Spain; the same thing was occurring in Algeria; and he feared the result of the French interference in Tunis and Tripoli would be to put a protective duty upon it from there. Everything, therefore, pointed to the desirability of developing the resources of India and Burma, so that we might be independent of foreign nations.

Mr. F. Barlow said he had just returned from Burma, but his tour only consisted of a three months' hurried journey through the country, so that he was not competent to say much on the subject. He was most heartily received by Mr. Bernard and all the officials, and it so happened that he was included in the census in some out of the way village near the frontier, from which in fact many of the inhabitants had gone over the frontier, fearing something was going to happen to them from the census papers being sent round. No one had alluded to the Burmese themselves; but they were the most charming and interesting people he ever saw, except the Japanese, whom in some respects they much resembled. The women were exceedingly pretty, and dressed in the most graceful and becoming way. The men were always cheery and nice, and you became friendly with them at once; very different from the natives of India. Whether Mr. Routledge would get over the labour difficulty he did not know, but he never saw a Burmese man work at all; he made the women cut wood and draw water, and employed Malagasy labour to gather his produce and till the ground. The inhabitants of the hills were of a more barbarous type; their cultivation consisted in burning down great tracts of forest; and at present the Government was trying to confine them to given districts, so as to preserve the teak. In one district when he was there, they came and asked leave to burn the forest, and were told they might do so if they would plant young teak trees and keep them weeded; but this concession they declined, knowing that when once the teak was planted, it would be strictly preserved. He might, perhaps, say a word or two on the question of opium. He travelled with the Chief Commissioner over a great part of Burma, and at every village he turned into the opium shops to see what effect opium smoking had on those who indulged in it. Those who came out were certainly horrible looking specimens, but when you asked one who, from an extraordinary look about the eyes, was evidently a confirmed opium smoker, how long he had taken to it, the answer always was, just two months ago, whereas he had probably been indulging in it for something like twenty years. It was a question, he thought, whether a total prohibition of opium in a malarious country would be wise. It was probably a useful drug in its way, and with it, as with most other things, moderation would do no harm; it was the excess which did the mischief. In Burma he doubted whether it was excessively indulged in to any great extent; but he had only gathered his information second hand.

Mr. Christian Mast hoped he might be permitted, as a native of a foreign county, but as an Englishman by naturalisation, to express the great pleasure he had felt in hearing about a foreign country like Burma, and the way in which this province seemed to be administered. He had often listened to papers read in that room, but rarely with such pleasure to an exposition of the mode of action in a British province as he had that evening. Very often they had heard about spreading civilisation in a manner which, if analysed, was anything but civilisation; but, to-night, they had heard that the real means of civilisation, namely, education, commerce, and trade, seemed to be employed in Burma, and the rulers seemed also to

enter into the spirit of the people, and not to run counter to their inclinations. He was much struck with the skill with which the governor seemed to have found out what the people liked, and to have escaped running counter to their religious feelings, so that for once the English race went hand in hand, he would not say with a semi-civilised race, because the Buddhists were highly civilised, and their civilisation was older than the English, but with an old race, and he hoped it would always be so.

Sir Arthur Phayre, in reply, said he was glad to hear it stated that steamers had gone up from Mandalay to Bamau last year as usual, as it showed the trade with the frontier of China was likely still to go on, without any further interruption. The time he alluded to was 1879-80, when, according to his information, there had been no steamers. He had been asked, with regard to the literature of the Burmese, whence it was derived, and whether it had been influenced by the Chinese. As far as he knew, the ancient Burmese literature had not been influenced by China; but he spoke with great diffidence. He believed the Burmese were taught letters by Buddhist missionaries from India—probably from Gangetic India—but the present literature of the country might be said to be derived almost entirely from the Pali literature of Ceylon. From that, a vernacular literature had arisen; much as, they might suppose, the literature of England arose or had followed, from the Latin used in the Middle Ages. He had lately heard that remarkable discoveries had been made as to the extent of the Pali literature. While he was in the country, no researches were made on the subject; but, within the last two years, a German gentleman had been appointed Professor of Pali in the High School of Rangoon, and he had made some very remarkable discoveries as to Pali works existing in the country, and also as to translations into Pali from the Sanscrit, and again from that into the vernacular.

The Chairman said that, so far as his information extended, and certainly what Sir Arthur Phayre had adduced confirmed the impression, whatever discussions there might have been at the time, or difference of opinion as to Lord Dalhousie's proceeding in annexing the territory of Burma, the inhabitants had been only gainers by the process. Not only had their numbers more than doubled, but the commerce had quadrupled; in fact, there appeared to be all the evidence of improved government, and of the perfect freedom of development necessary to the welfare of the people. Certainly, if they had any doubts as to the mode of proceeding in different regions, it was a great satisfaction at least to know that there could be no question as to the results on the welfare and happiness of the people that came under our rule. Mr. Routledge had given some very interesting facts with reference to paper-making which had especially interested him, the "bamboo" being a very old friend of his. He had spent great many years in two countries where there was this singular state of things. In China, where rags abounded, they never used a bit of rag in paper, but it was entirely made of bamboo. In Japan, where also they had abundance of rags—in fact, they were a perfect drug in the market—they neither used them nor bamboo, of which they had plenty also, but the bark of the mulberry tree, with some twigs of other shrubs. The bamboo paper, which was well-known to artists many years ago, being specially favourable to fine proof impressions from copper-plate, was called India paper, because it was brought home in India ships; but it was really China paper, and there it existed to this day. That colossal empire, like other megatheria, moved very slowly, and had not shown the slightest dispositon to use either rags or mulberry bark. The bamboo paper had one objection, that it was exceedingly perishable and brittle; it tore with the slightest effort, whereas *that shown* by Mr. Routledge was cured of this defect. Japanese paper also, though often as fine was almost as difficult to tear. Of cou China and Japan, the paper was made ink, which again was really Chinese ink. T with their marvellous development of ind last ten or twelve years, had now got v mills on the European pattern, and made a paper entirely of rags or rag mixed with othe The Chinese, on the other hand, went on bamboo paper as they did 3,000 years ago, a he could see, would go on doing so for a years. Mr. Routledge's bamboo paper was m in many respects to that of the Chinese thou been using it so long. He supposed it would to have crushing machinery wherever the c might be drawn from, in order to reduce th some manageable condition for freight. were rocked in bamboo cradles when they fed with bamboo, and beaten with it whe growing up; they lived under it in their ho fact, without bamboo one could scarcely und a Chinese population could exist. There di to be any trace of race hatred or religious f Burma, to prevent harmony between governors, as there were in China, where were continually being massacred, and burnt over their heads. He had not heard of that kind in Burma, and he presumed were a more easily governed race, or had l judices. They must all rejoice at the g which Burma had made under the aus Arthur Phayre; and, in conclusion, he wo cordial vote of thanks to him for the very interesting paper which he had given them

Sir Joseph Fayrer, F.R.S., said he was not usual to second the vote of thanks on th but he would ask leave to do so in order words. He could hardly express the gre gave him to be present that evening, when of 28 years ago, at which period he had t serving in Rangoon with Sir Arthur Phay being the first Chief Commissioner, and he Medical Officer. At that time he could anticipated that at so distant a period h had the great gratification of seeing Sir A in such excellent health, and of hearing gratifying an account of the country he had governed. The population had been doub more than doubled; the revenue had been everything had prospered. The nation w contented, and had preserved its indivi religion was undisturbed; the people had and contented throughout the whole of Burma which had had the good fortune British rule. They might indeed congratula Phayre upon this state of things, as no on that it was mainly due to his administrat

The vote of thanks passed unanimously, ceedings terminated.

A paper on "British and Upper Burma, W. F. B. Laurie, was printed in the *Jou* 11, 1880 (vol. xxviii, 640.) On p. 644, col "British Burma" should be read "Uppe

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TWENTY-THIRD ORDINARY ME

Wednesday, May 25th, 1881; W. Memb. Inst. C.E., in the chair.

The following candidates were p election as members of the Society:—

s Barnes, 77, Old-road, Middleton, near and Jessamine-house, Barton-on-Irwell,

Albert, 97, Finsbury-pavement, E.C.
uel, 11, Queen Victoria-street, E.C.
ard, Dartford, Kent.
omas Ruddiman, 108, George-street,

eric, 5, Porchester-gate, Hyde-park, W.
., Frognal, Hampstead, N.W.
lliam Henry, 14, Essex-street, Strand,
Vimbledon-hill, Surrey.

ng candidates were balloted for, and nembers of the Society:—

l Peto, M.A., The Holmwood, Bickley,

Ingham, West Ham Abbey, Stratford,

s Maskall, 340, Brixton-road, S.W.
um, Tower Chemical Works, Victoria

Malcolm, Imperial-chambers, Bowlalley-

um Purdie, 69, Ludgate-hill, E.C.

rned Discussion of Mr. Alexander per on "Electric Railways, and Transwer by Electricity," was resumed.

n said that amongst the numerous in- 1 had characterised the past two or three plication of electricity to useful purposes, succeeded in inventing a process by which ly could be in two places at one time, and such an invention had prevented him from when the paper was read by Mr. Siemens, e admirable manner in which the proceediety were published, he had had an opporilly studying the paper. From one point of r reflected the very greatest credit upon its e it was eminently a practical paper, and le manner with a very abstruse, difficult, ject. Unfortunately, in the present day, g tendency to push practice on one side theory and imagination very much to the is was especially the case with certain e particular country, practice was thrust vildest imagination allowed to gallop in the spapers with the greatest possible nonsense. ething in electricity that gave a latitude of this imagination: it was something thing that at once, by its marvellous the telephone, the electric light, and purposes, seemed to carry one beyond the o an age somewhere beyond the days of hers, and, as a result, they found, whenation of electricity was proposed, that a nonsense was talked and written. A few er appeared in the *Times*, written by some happened to be in Paris, where he was a battery known as Faure's secondary lescribed briefly this wonderful battery, velling night and day to Glasgow, ; it with Sir William Thomson, it was at gentleman as "a little witch." This racted attention, because people had been that it was a process by which electricity l, carried about, and utilised for various ently, when in Paris, being somewhat of a f mind, he (the Chairman) examined this ly, and came to the conclusion that there n it. The battery had a pretty high amount equal to about 2½ Daniell's cells, but it f very low internal resistance, and, therefore, able to give a considerable current. In all questions of this kind where electricity was applied, a very important element was introduced, viz., the element of time. It was perfectly feasible and practical to produce a powerful current of electrity that would last a minute, or even three minutes, but for lighting and tramway purposes, or the ordinary power purposes in arts and manufactures, they wanted something that would last a very much longer time. This particular battery, that was supposed to store electricity, lasted but a short time; it gave a powerful current, it was a pretty thing, but it was not at present practical. Again, to illustrate the fact that imagination rather departed from practice, he might mention that, not long ago, a paper was read before the Society by no less an authority than Professor Perry, in which he said that he believed that, at no distant date, they would have great central stations, possibly situated at the bottom of coal pits, where enormous steam-engines would drive enormous electric machines; that wires would be laid along every street, and tapped into houses like gas, and registered by a meter; and that electricity would be used for driving machinery as well as for giving light. Now, judging from practice, he thought there was about as much probability of such a state of affairs arising in this country, as there was of being able to emulate the example of the young ladies mentioned by Bulwer Lytton, who put wings on their shoulders, and floated about beautifully in the air. There seemed to be in the present day a great tendency to ignore experience. He had been personally engaged in the practical application of electricity for over 30 years, and scarcely a day passed without his dealing in some shape or form with electric currents, consequently he might fairly claim to have some practical experience in the application of electricity; but on mildly venturing to suggest that a certain firm engaged in establishing the electric light was committing what might be regarded as a crime in the telegraph world—he was told that telegraph men knew nothing about electric light currents. Now, if anyone did know anything about electric currents and the disturbance to which currents were liable, they were telegraph men; and in the question of the transmission of force to a distance, and the application of electricity to certain purposes, he thought there was some experience in the telegraph world which might be of service. For instance, it was proposed to transmit to a distance currents for the production of electric light and for the production of power. Many persons were aware that on previous occasions he had spoken of the application of the electric current to lighting purposes, and had thown some cold water upon it, for the simple reason that the experience of telegraphists showed that it was impossible, with their present knowledge, to distribute electric currents through towns and other places, so as to carry out the dream of the projectors of electric lighting enterprises. The question of the transmission of power was an entirely different matter, and the difficulties in its way were of a totally different kind to those attaching to the unlimited division of the electric current. He maintained that the sub-division of the electric light with the notion of entirely supplanting gas was as futile and as absurd as the philosopher's stone. Although there were difficulties surmounting the transmission of electric current for the purpose of the transmission of power, still they were not so great, the chief reason being this, that to distribute light over a large area, or through a town or a number of houses, you must have a very high electric motive force; whereas to distribute the electric current for the purpose of producing power you did not want a high electric force. High electric motive force meant danger to the wires conveying the currents, as had lately been seen in the case of one of the companies now illuminating the City, the electric current having broken down the wires. Having said something on the merits of Mr. Siemens, it would now be as well to make what remarks

he had to make in criticism of him. He liked his paper, but he did not like his mathematics. He would not go very deeply into that point, because it would doubtless be considered a bore by the audience. The mathematical part of the paper seemed to be based on the labours of Dr. Frölich; but here was introduced a term which seemed to require some explanation, which he hoped Mr. Siemens would be able to give. That was the use of the term "effective magnetism" to express what was in reality electro-motive force. The electricians present would feel that that to apply a function of electro-motive force as an effect of the machine was to commit what logicians called an anomaly magnestism. Again, to explain something which was very simple in itself, he had been compelled to introduce what were called Foucault currents. These currents were currents created by the author to account for certain effects of heating observed in the armatures magnetised; but he thought what took place could be explained better by another well-known cause. It was shown in the paper that there were certain relations existing between the power put into one machine, and the power taken out by the other; and the whole practical value of the paper, and of the transmission of power by electricity, depended on the exactitude of these formulæ. He did not question the formulæ themselves—they were perfectly exact, but he wanted to enlarge them a bit in order to explain the anomaly which was found there, for which Foucault's currents had been invoked. If you had an armature wound with wire, revolving at a given velocity, and springs pressing against it to take up the current produced by the rotation of the armature between the poles of a powerful magnet, either a permanent or an electro-magnet, the wire from one of these brushes might go to earth, the other might be attached to the wire of one coil of an electro-magnet, and pass through the other coil, and then through a wire of any length to another similar apparatus, with a rotating armature and springs, and then to earth. In the one place magnetism was produced, and a coil of wire rotated with great velocity within the sphere of that magnet. The result was that currents of electricity passed along the line wire, it might be 100 yards or 10 miles, and then they came to another armature, precisely similar to the first; they passed through it, through the coils of the field magnet, where they produced magnetism, and established a field which produced mutual reactions between the currents of magnetism, and thus caused the second armature to rotate. [Mr. Preece drew a diagram on the black board to illustrate his meaning.] It was the rotation of the second armature which was utilised as power to turn machines, drive railway trains, and so on. He would point out that there was a certain relation between the power applied to the first machine, called the generator, and the power developed in the second machine, called the motor. The electric current developed by these machines was an exact measure of the power put into the machine, so that a proper instrument of this kind would be one of the most accurate and exact dynamometers a mechanician could use for small powers. Now the relation between the first machine and the second was given by a very simple formula. You could find anywhere the horse-power expended in the circuit by multiplying the electro-motive force by the current in the circuit, and dividing it by the resistance. In the second machine the electro-motive force was called E_2, and the formula showing the amount of work was—

$$W_2 = \frac{E_2 (E_1 - E_2)}{R}.$$

In the first place there was the coil rotating very rapidly by direct application of mechanical force in the field of a magnet, which produced the electro-motive force E_1. This produced a current through the system, and this caused the second armature to rotate. But it rotated in *the opposite* direction, and by so doing it set up a counter electro-motive force, and therefore t[he current] in the circuit was produced by the differenc[e of] the two forces; and so they got the above [formula]. Now, since E_2 is a variable, we can differentiat[e the] equation with respect to it, and by putting its co-efficient = O, we obtain the maximum re[sult that]

could possibly be obtained. This occurs when

There was force put into the generator to obta[in work] in the motor; and it was impossible that the [rotation of] the second could equal the first, because then t[here would] be no current at all; therefore the rotation of t[he second] machine must be less than the first. On the ot[her hand,] the rotation of the first must be pretty [...] there would be no work at all. It follow[ed from] the formula he had given, that to produce the [maximum] effect, the electro-motive force in the motor must be exactly half that in the generator. [On referring] that to Mr. A. Siemens's figures, they found that [the] effect of every machine was at a maximum [when the] electro-motive force of the motor was half t[hat of the] generator, when the velocity of rotation of [the motor] was half that of the generator, and when als[o the work] done in the one was just half that of the [other. Dr.] Hopkinson and others had shown that in [a good] dynamo machine you had 90 per cent. of e[nergy con]verted into electro-motive force, and they [found] it proved that the power given out by [the second] machine was half that of the first. [That] was, if you put 5 h.p. on to the first m[achine, you] got a little less than 2½ h.p. in the moto[r, because] half 90 per cent. was 45 per cent., an[d that was] about what Mr. A. Siemens said was [the amount] of force given out. He had shown them t[his ought] to be so, and, therefore, there was no neces[sity for con]juring up imaginary Foucault currents to [explain] the result. Mr. A. Siemens, however, was [...] when he stated that it would still be econom[ical to use] large stationary engines to work small m[achines] at a distance, because large engines onl[y used] 2½ lbs. of coal per h.p., whilst small ones [used] six pounds. But there were difficulties to b[e met.] As regards distance, that was nothing; t[he] distance could be easily got over; but [there was a] serious difficulty when you came to a[pply it to] small motor machines. All these theories [were] true when you were dealing with o[ne machine] driving another machine; but when you tal[ked of wires] being laid along the streets, tapped into hou[ses like gas] pipes, you introduced not one opposing force, [but 50,] or it might be 500; and here the practical e[xperience of] the telegraphist came into play. They knew [what it was] to introduce many instruments on one cir[cuit. When] there was only one instrument on a circuit, [they worked] at 250 or 300 words a minute, but when t[hey came to] apply intermediate stations and additional [instruments,] the speed ran down by the introduction [of the] counter electro-motive force, and the ef[fect] was reduced accordingly. There were oth[er points] to which he would not stop to allude. [He would] conclude by again expressing his sense of [the value of] Mr. Siemens's paper.

Dr. Siemens, F.R.S., said Mr. Preece, w[ith his well-]known ability, had just shown that the power [given out] from the motor machine could not exceed [half that] communicated to the generator. That, ho[wever, was a] question which had been much discussed a[mong elec]tricians, and Mr. A. Siemens had adopt[ed the safe] course, of rather under than over-stating [the results] which might be and had been obtained. [There was by] no means such a limit as 50 per cent. Ex[periments of] undoubted accuracy had shown that you [could obtain] 60 or 70 per cent., and that the point of ma[ximum effect] was not limited to half the velocity; the[y ...] agreed with Mr. Preece that there was a li[mit; if the] velocities were equal theoretically, the max[imum] should be obtained, but the counter curr[ent ...]

se was also a maximum, so that practically .um lay between the two results of half velocity velocity. He had in his hand a report, received day, with regard to the working of the little t Berlin, in which his brother put it, as the observation and measurement, that 60 per cent. effect was realised; but this was under very conditions. And it was one of the remark- tures connected with the electric transmission r, that as the resistance to be overcome in the carriage increased, so did the force increase to e the resistance. Thus, in going on a level, er used to propel the train might be 10 h.p.; en the train ascended a gradient of 1 in 80, was the steepest on the line, then the power ry to drive the dynamo machine at the increased, and the power transmitted to the increased in a still greater ratio. Indeed, surprise to everyone who had investigated railway to see with what determined force the ascended the incline, with comparatively little of velocity. Of course, in order to overcome er resistance, the velocity had to decrease. It d in the paper that the velocity of the train had ited to ten miles an hour; but, seeing the with which the train ran, greater speed had ved, and the carriages had gone to the distant d back in seven and a-half minutes, which average speed of about twenty-five miles an difficulty had arisen, as happened with most tions, and this difficulty was of a most peculiar the Berlin railway, one rail conducted the owards the carriages, and the other took the station. Now, if a man passed over the level crossing, no harm was done, because he ot on only one rail at a time; but a horse lowed with four feet, he sometimes put one ne rail and another on the other, and thus ed a most inconvenient shock, so much so, es decidedly objected to these level crossings, ame necessary to make some special arrange- avoid this inconvenience. It sufficed to put t the crossings out of circuit, and to connect ard and forward rail electrically. This experi- wed the practicability of the system, but his tirely agreed with him that it was not by any be supposed that the electric railway would omotive engines from our great thoroughfares. ric transmission of power would be efficacious, for local traffic, such as tramways, and also onveying minerals from the interior of a mine nk, and in exceptional cases for the trans- f heavy trains along rails. One of those cases ented by the St. Gothard Tunnel. The com- which that belonged were fully alive to all mprovements, and had requested them to work n for utilising the hydraulic power, which could great abundance near the mouth of the tunnel, assage of the train through the tunnel. By plishment of that object, very great advantages gained; for, as those who had travelled through Cenis Tunnel, or through the one on the line Alessandria and Genoa, were aware, great in- nce resulted from the emission of the products stion from the engines during the transit. If ould be sent through this long Alpine tunnel ic force, a great inconvenience would be saved ssenger, and at the same time a great saving effected for the company. Nearer home there e which would lend itself admirably to electric ion—the Underground District Railway. All o were in the habit of using that railway ed the facilities it offered in going to the rom it; but they also felt the inconveniences oducts of combustion choking the atmosphere. l been proposed for more thoroughly ventilating el, but they were only palliatives; the cure would consist in finding a source of power without the inconvenience of combustion being carried on in the tunnel. A plan had been proposed for working the engines by compressed air, and he had nothing to say against it, but it did not do away with the necessity of having an engine nearly as heavy as the present locomotive. He believed if electric transmissions were tried on that railway in such a way as to make the rails act as the return conductor, making them all "earth," and fixing guide rails under the roof for the conveyance of the current, to be taken into each carriage by means of a metallic rope, great certainty of action would be obtained, and the trains would be propelled through the tunnel without fear of their being stopped midway, and at a very economical rate. These were the features of this innovation; that it lent itself to the conveyance of power to any reasonable distance, and that it could be applied without any of those inconveniences which now beset our locomotive traffic. He hoped that before long a trial would be made of the system, not, perhaps, on a very large scale at first, but sufficient to show its merits.

The Secretary said he had written to Sir William Thomson, with a view of having the secondary battery which had been alluded to shown; but Sir William informed him that he and Mr. Bottomley were engaged on a series of tests in connection with it, and, until they were completed, he could not let it leave Glasgow. Otherwise, he would have been very pleased to send it.

Mr. Hale was not very sanguine that this method would answer for the Metropolitan District Railway. The line was not all tunnel, and he did not understand from Dr. Siemens whether he intended trains only to be taken through the tunnel by electricity, and then on by an ordinary locomotive; but, if so, that would be a great obstacle and delay. The locomotives were very heavy, and even the carriages weighed 12 to 14 tons each. Again, did he understand that the influence of the transmitted power would be as great 30 miles from the central station as a few miles only? It occurred to him that that was, at present, only theory. He should like to know the weight of the carriages on the Berlin line, and if the figures quoted of the cost were absolutely exact.

Mr. J. N. Shoolbred wished to add a word or two to what he had said last week in regard to the efficiency of electrical machines. Dr. Hopkinson had read a paper at the Institution of Mechanical Engineers, as to the efficiency of electric machines, as Mr. A. Siemens had stated; but a year later, Mr. Gray, of Silvertown, had also given the result of a similar series of experiments, which he had carried out during the interval with a Gramme machine, the one used by Dr. Hopkinson being a Siemens. On the wall were two diagrams, showing the results of each series of experiments, and it would be observed that there was a wonderful similarity between the curve shown as developed by the Gramme machine, and the curve shown by Mr. Siemens, as the result of experiments carried out on a similar machine by Meyer and Auerbach. The peculiarity about it was the sudden dip at a certain point, near the end, which Dr. Hopkinson suggested must have been due to a slip in the driving band, or some accident of the kind. Mr. Gray, however, felt quite certain that such could not be the case, but "that it was due to the magnetism of the field magnets falling off, after the external resistance had been reduced beyond a certain point; and was somewhat analogous to the action in a battery due to polarisation. This effect would be produced in a Siemens's machine only when the external resistance, had been still further reduced than in the case of a Gramme machine." The curve of Dr. Frölich's experiments on the Siemens machine also confirmed the accuracy of this statement. With regard to Mr. Preece's remarks, he had long hesitated about accepting the dictum that the loss of power must neces-

sarily be 50 per cent., and he must now decline to accept it, especially as the opposite view was confirmed by the remarks of Dr. Siemens and Professor Ayrton. Generally, two machines of similar construction had been used, but if instead of that the secondary machine was of a lower electro-motive force, you would thereby increase the difference on which the effective result depended. Some time ago he had occasion to try experiments with different sized machines, and he at first drove with a large machine using a large amount of mechanical power, but with a low electro-motive force; whilst the secondary machine, being smaller, had a higher electro-motive force. He then reversed the machines, and drove from the smaller machine, which required a smaller amount of energy, but which possessed in its internal construction a higher electro-motive force than the bigger machine; and the same amount of work was then done with a smaller expenditure of mechanical energy. Consequently, in the second case, where a machine with this lower electro-motive force was the driven one, you got a better result than in the first instance. The main point was to get as great a difference as possible between E_1 and E_2, but you could obtain that not merely by difference of speed, which could be obtained with two machines of the same kind, but also by employing two machines having each a different electro-motive force. Speed was a matter which settled itself according to the load. A high speed in the generator meant a large amount of power; a low speed in the motor meant that it was doing a large amount of work. What Dr. Siemens had said about the effect of inclines on the railway, came to much the same thing. It had been explained by Dr. Siemens in a very interesting way in a paper read before the Society of Telegraph Engineers. The difference of potential between the two machines was at a maximum when the second was at rest; the moment it started, it went at a tremendous velocity, and until they settled down to work, it increased in velocity. The effect of ascending the incline was to throw more work on it, diminishing its own speed, and, consequently, the augmenting potential of the other one. He would refer anyone who was interested in the subject, to this paper of Dr. Siemens, where it was most clearly explained.

Mr. Donnithorne said he had noticed a spark at the point of contact between the wheel and the rail last week, and he wished to ask whether there would not be a loss of power in consequence.

Mr. Bright (Mayor of Leamington) asked whether there would not be a danger in wet weather of the electricity passing from one rail to the other, in the same way as when the horse stood upon it.

Mr. Dipnall asked whether this system would be applicable to large ocean steamers and purposes of that sort.

Mr. Clements thought there was not any great difficulty in understanding this subject, especially as there was a railway now in operation, which would give great encouragement to the opening of other railways of a similar kind, which he hoped might be tried. They all knew the great difficulties which the present railway schemes had to contend with at their inception, especially from the immense Parliamentary expenses, and perhaps these might be saved in the case of electric railways. He referred to the various difficulties which beset ordinary railways, and thought the present gauge was too wide. It would also be a great advantage if the power of water could be utilised as had been suggested.

Mr. Crompton, being called upon, said he had used the transmission of power by electricity experimentally in lectures, and for such purposes, and had driven machines at a distance, but he had not measured the power employed at the generator, or given out at the motor; and without such experiments he did not feel that he could add any valuable information to what was before the meeting.

Mr. A. Siemens, in reply, said he would not
the audience very long with replying to objecti
the theoretical part of the paper, and would
Messrs. Ayrton, Shoolbred, and Preece, all in
begin with, it was true he had applied the letter M
formulæ to electro-motive force; that was bec
already had two letter E's, and he thought it w
clearer if he followed the example of Dr. Fröli
called this electro-motive force unit M; it was
not to have too many letters E in the formula
Preece had very ably explained how he arrive
equation he had given, but he had overlooked
same equation had been given in the paper,
diagram on the wall showed that the work do
second machine was equal to a constant mult
the electro-motive force of the second machine n
by the current. The current was equal to th
motive force of the first machine, less the elect
force of the second, divided by the resistan
you replaced C, by this expression, the equat
be the same as that given by Mr. Preece.
hurried over the theoretical part of the pape
he did not want to be too scientific in a Socie
to applied science. As regards Mr. Shoo
suggestion that the difference should be a
possible between the two machines was n
as according to mathematical rules the pr
maximum when E_2 is exactly half of E_1;
fore could not agree that the second mac
have as low an electro-motive force a
Professor Ayrton and Mr. Shoolbred re
machines with permanent magnets, instead
machines, but he could not agree in that
they all knew that these magneto machine
known for over 40 years, had never bee
transmitting power. That fact alone s
they were not fit for the purpose.
exciting all dynamo machines by separate e
had also been treated in the paper, by Dr. Fr
Preece rather doubted the presence of th
currents, and seemed to think that I
or himself was the originator of them,
was not so. In some machines they
bobbins revolving in a powerful mag
they began by protecting those bobbin
them in shape by putting small copper pla
side, and they then found that simply t
machines, without closing the outer circuit
great power, and that these plates got
heated, although there was no curren
passing through the wires of the bobbin
simply the Foucault currents circulating i
plates on the two sides of the wire, which
heat, and made the exertion of power nece
same thing happened if, in a dynamo m
iron armature was quickly moved in
field. He might also say that the m
Siemens had alluded to of having separ
wires suspended overhead, instead of usin
for the two leading wires, was going to be
tramway in the suburbs of Berlin, where a
riage would run on the wire and be connec
ordinary tram-car by a metal rope, the ordi
the tramway serving as a return conductor.
at once answer one of Mr. Hale's question
an electric railway were to be applied to
politan lines, the wires connecting the cur
carriages would be suspended in the tunnel
the roof, and between the tunnels they
supported on poles. It had been said th
be very difficult to distribute the current
because you had not to deal with the s
tion of having one machine generating
and another utilising it, but you mig
lot of machines, some going and some

e into the details, because he wished to per as practical as possible. As regards on the Metropolitan Railway, it would e, be possible to take one of the small had shown to pull a heavy train, but it quite practicable to construct more chines for the work. Dr. Siemens had at there was a scheme on foot for running h the St. Gothard Tunnel by electricity; they would have to have a locomotive to eam locomotive at the mouth of the tunnel, ise the same rolling stock; the electro- would be just as heavy as the locomotive, ave the same adhesion, and there was no the passengers in the train. He under- comotives were often changed on English l in the case of the express which went to passengers took refreshments while the nt on; if, therefore, the time lost in ocomotives were the only difficulty, they a refreshment-room at the mouth of the hen no one would complain; but, of course, politan lines, special rolling-stock could be d a special dynamo machine could be put age, and then trains could be made up in y, long or short. Of course, he could not v and run an electric train on the Metro- ray, or even lay a full scheme before the r the purpose; what he wanted to prove electric transmission of power had made a f progress during late years, and was ertain circumstances, and would no doubt be to the distance from the stationary engine, in a circuit was so small that it would make difference if it were extended to thirty gards the cost of the railway, that was the f the paper where he had dealt with d not facts. The items, of course, were the greatest possible accuracy, but accord- prices, where labour, and also iron, he heaper than in England. Another ques- as to what would happen in wet weather. m Lichterfelde had worked exceedingly weather. It had excited a great deal of l a deputation from the Society of Railway Germany paid a visit to it, and fortunately wet weather, when the rails were rusty and uite damp. The tension, however, of the g so very low, the resistance of the wet still sufficient to keep the insulation, r ran along just as if it were dry f overhead conductors were used they sulated, as the present telegraph lines t weather would have still less influence. to the little machine showing sparks on that was due to its small weight, if it had the wheels would have made better contact , and no spark would have been seen. He the electric transmission of power would be steam-ships because you must have some rk the primary engine, and a secondary w to work the propeller, and if you had a on board it would be more advantageous rectly to the screw. The only other way lifficulty would be to have a stationary re connected with the ship by a cable, and l be very awkward if the cable broke. It l by several speakers that if the secondary turned with the same speed as the first, ual E_1, and there would be no current. ractical turn of mind, he thought it would try that, and so he had two machines tried, nning at 684 turns per minute, the secondary ming loose, ran 730, or 46 turns quicker rst, and at that time there was a hree webers going through the system. l a brake applied to the second machine which brought it down to 652 revolutions, a little slower than the first, and then the current increased to 7·8 webers. Then he had another experiment made, because he thought it might be objected that the first machine had a greater or smaller electro-motive force than the other; he therefore reversed them, and made the secondary one the primary, it was then driven at 682 revolutions, there was a current of 4 webers, and the second one ran at 755, or 73 quicker than the other. Then, again, he applied the brake, and he found the primary machine ran at 690, and the second at 684, there was a current of 7·8 webers, and a little bit of work done, ·07 h.p. This seemed to contradict theory; but he thought the explanation would be found in the mode in which the brushes were applied to the revolving armature; because, when applied in the most efficient manner, for the machine turning in one direction, they would be not properly placed for obtaining the greatest effect when the direction was reversed. Therefore it was possible to drive the second machine a little quicker than the first, although the theory seemed to prove that it was impossible.

The Chairman, in proposing a hearty vote of thanks to Mr. A. Siemens, for his able and practical paper, said the weight of the carriage was not of much consequence; if the carriage weighed 20 tons, it would require 160 lbs. to pull it; and inasmuch as by the system of electro-dynamo machines, they could, without difficulty, transport to a distance of 20 or 30 miles, as the case might be, from 5 to 10 h.p., it was quite evident that whatever might be the weight of the carriage, Siemens's currents would be strong enough to move them quite fast enough. He was afraid that Mr. Alexander Siemens, at one time, was going to upset his own theory, for he proved that, when the machines ran under certain circumstances, these ran at nearly the same velocity; in some instances, the second machine ran faster than the first, but he took care to let it be known that the second machine was doing no work. Now, it was well known that one could not have his cake and eat it too, and if you had a machine, as the second machine, driving a wagon, the power could only be utilised at the expense of power absorbed elsewhere. If you put a 5 h.p. into the machine at one point you would, under the circumsances, only get 2½ h.p., the other 2½ h.p. being absorbed in heating the machine. Notwithstanding what Mr. Shoolbred had said, he was prepared to stand on the formulæ he had given as being correct, according to experiments which had been made, and, moreover, it accorded with facts. The advantages in favour of electricity were the ease with which the power could be transported from place to place, the cheapness with which it could be utilised to different purposes, its freedom from danger, and, above all, it fulfilled to the very highest degree one of the principal duties of the engineer, namely, the utilising for the benefit of mankind the waste forces of nature.

The vote of thanks having been unanimously accorded, the meeting terminated.

MISCELLANEOUS.

ART FURNITURE EXHIBITION.

The private view of the Exhibition of Works of Art applied to Furniture, promoted by the Society of Arts, in connection with the Fine Arts Exhibition at the Royal Albert Hall, was held on Saturday, 21st inst., and the Exhibition was opened to the public on Monday, 23rd inst.

The objects are arranged in a series of twelve bays in the galleries round the hall, each bay being arranged by a particular firm.

Bay No. 1 contains a cabinet of carved walnut-wood, an octagon table of the same, a cabinet of satin-wood, and chairs, exhibited by Messrs. J. G. Crace and Son, besides stained glass by Messrs. Heaton, Butler, and Bayne, and china by Messrs. Minton and Co.

Bay No. 2 contains a screen showing the side of a room decorated in the English style of late 18th century, with silk in the panels, and an oval mirror in a gilt frame of same period on the centre of panel; satin-wood cabinets, pole-screens, and arm-chairs, marqueterie writing-table, mirrors, &c., exhibited by Messrs. Morant, Boyd, and Blanford; also three dishes of gold lustre-ware, by Mr. William de Morgan.

Bay No. 3.—The walls and ceiling are decorated in the Louis-Seize style, and the bay contains a cabinet and chimney-piece in the Oriental Greek character, composed of boxwood, ivory, pear, ebony, and other woods; several other cabinets, tables, chairs, &c., and various specimens of old Japanese lacquer, and Chinese and Japanese ornaments, exhibited by Messrs. Jackson and Graham; also wrought-iron dogs, by Feetham and Co., and combination gaseliers in ormolu, and cut-glass, by Messrs. F. and C. Osler.

Bay No. 4.—Messrs. Gillow and Co. show part of a room in the Italian style. The walls are hung with green velvet, the embroidered borders executed from designs of the firm by the School of Art Needlework. The Oriental carpets and curtains from Messrs. Vincent Robinson and Co. The chased metal works and ornaments by Messrs. Elkington and Co. Painted vases and tazzi, in the Italian style, by Messrs. Minton and Co.; and the Doulton ware and painted plates, by Messrs. Doulton, Lambeth. The stained glass window from the Royal Stained Glass Works, Windsor, and cut-glass, and chandelier, supplied by Messrs. Webb and Co., of Stourbridge. Messrs. Gillow exhibit mantelpiece, carved walnut secretaire, satin-wood cabinet, tables, seats, tripods, &c. Wood carvings of birds, of a Shakespeare cabinet, and of the head of Shakspeare, by Mr. W. Perry.

Bay No. 5.—Messrs. Holland and Sons exhibit a *dressoir* for dining-hall, of oak, inlaid and relieved with gilding, the centre of canopy surmounted by a tablet with carved subject, and mottoes from Pericles, the metal work entirely of hand-wrought brass, designed by the late B. J. Talbert; a cabinet in ebony, designed and partly executed by Barbetti, of Florence, and a writing-table.

Bay No. 6.—Messrs. Howard and Sons exhibit a special treatment of wall elevation and embroidery, cabinet work and parquet flooring. The Barberini and Milton vases in carved glass, are exhibited by Mr. P. Pargeter.

Bay No. 7 contains a specimen of wall decoration of the 18th century, after the style of the Messrs. Adam, a mahogany inlaid sideboard, and cylinder writing-table of the same period, a pianoforte case of marqueterie work of Louis XV. period, mahogany writing-table of the 18th century, after "Chippendale," and various specimens of carving and gilding, all exhibited by Messrs. Wright and Mansfield.

Bay No. 8 contains *dressoir*, mantel-piece, chairs, and other decorative furniture exhibited by Messrs. Collinson and Lock.

The corridor contains specimens of Doulton ware, exhibited by Messrs. Doulton and Co., consisting of terra-cotta panels, designed and executed by Mr. G. Tinworth, decorative panels by Miss Jane Atkinson, tiles and plaque by Mr. Edward Sears; also stained glass by Mr. Sears, and Algerian carpets worked by hand by S. Moline, of Algiers.

Bay No. 9.—Messrs. Gregory and Co. exhibit a collection of cabinets, tables, chairs, &c., in solid rosewood, of the modern English school. Turkoman tapestry, curtains, and *portières* of a special manufacture, suitable for rooms where Oriental carpets, &c., are used.

Bay No. 10.—Messrs. Shoolbred and Co. exhibit carved cabinets, tables, mantelpiece, and furniture.

Bay No. 11.—Messrs. Johnstone, Jeane exhibit carved Italian walnut buffet, and d chair to correspond, walnut panelling for side room or hall, and specimens of stained glass in this bay is shown by Messrs. Minton an the metal work by Messrs. Perry and Co.

Bay No. 12.—The School of Art Wo exhibit a copy of 18th century Engli piece, 3 feet deal moulding, executed b L. Irwin, two pilasters by Miss F. E. M. Young, the fittings by Messrs. F Co. Mr. Sidney Phelps exhibits panels of two pairs of sconces, and a pair of fi iron-work. Mr. F. Gleeson exhibits an mounted with Mechlin lace, and carved f mother-of-pearl, ivory, tortoiseshell, and ebony. Messrs. Morton and Co., of Edinbu examples of Tynecastle tapestry, a new fa covering of walls, &c., the invention of M Morton. Mr. Thomas Jacob exhibits two cabinets.

With reference to the award of the Soci and certificates, it has been decided that the designers and art workmen who have l in the production of the art manufactures n shall be given to the jury appointed t medals and certificates of the Society of A the names of those to whom the awards ar be published in the *Journal*.

The Council of the Royal Albert Hall h present each member of the Society of Art transferable season ticket, and any membe such ticket can have one on application to Society of Arts.

THE PROPAGATION OF SPON CUTTINGS.

By C. G. Warnford Lock.

In a recent report on the Bahamas December 31, 1880, p. 102), Professor I called attention to the account of the ef the Austrian Government to improve spon the Adriatic, published by Dr. Emil von the Transactions of the Zoological-Bot of Vienna." The following abstract fro original will, doubtless, have an intere readers of the *Society of Arts Journal*:—

The history of the experiments, Dr. M misses in a few lines. Professor O. Schmid in the *Wiener Zeitung*, and in his work on sponges (both in German), expressed a co if a perfectly fresh sponge were cut into s and these were again placed in the sea, the and in time become perfect sponges. Thi the test by an experiment conducted i Socolizza, on the north-east point of the isl commenced in 1863, and concluded in No Success was rendered impossible by the u turbance of the locality with fishing nets actual robbery of sponges and apparatu worm, which contributed to the mischief l the woodwork used, was harmless in co the determined opposition of the local pop by a deep prejudice against the innovatio fortunate circumstances, however, did no accumulation of a mass of valuable info calculated to form a basis for the rep attempt under more favourable circumstan

The most suitable season for commenci gation is the winter. The growth of the the healing of the cut surfaces, proceed slowly in winter than in summer; but a l

dangerous, by reason of the great tendency of ...nge to undergo rapid putrefaction. In winter, a sponge may remain dry for several hours; in ...r, it is ruined in a few minutes after leaving the ...pecially if not constantly supplied with fresh ... Buccich placed some sponge cuttings for eight ...n a shady airy place, at a temperature of 7° R. ...), in the month of February, yet all grew.

...locality, choice should be made of bays sheltered ...ong waves and currents, but not quite still; the ...should be rocky, and clothed with living algæ: ...re should be a moderate ebb and flow of the tide. ...ses, the neighbourhood of the mouths of brooks, ...and subterranean springs must be avoided. The ...s and liveliness of colour of the marine algæ ...indications of a suitable spot. The worst enemy ...ge culture is mud. Under certain circumstances, ...sion of the bay by means of a chain across the ...is to be recommended.

...ponges chosen for cutting must be gathered by ...sed hands, with all possible gentleness. They ...red either by tongs or by drag-nets. One arm ...ngs is fixed to a long stake, the other is mov... ...l can be advanced towards the first by a noose, ...own the stake by the collector; objects coming ...the crimped ends of the tongs are thus held ...can be drawn up to the surface, of course only ...ight depth, such as the eyes and the stake can ...to. The sponges must either (and this is the ...ical point) be taken up with their roots entire, ...rust be torn from them, whereby a prejudicial ...r serious wound may very easily be inflicted. ...und at Lussin and Lesina, that when the men ...of O. F. Müller's or Ball's drag-nets, or even ...sembling the "trawl" of the English and ...deep-sea fisheries, the sponges were nearly ...rought up in good condition. It is also very ...ortant, when collecting sponges for subdivision, ...a certain selection, as the malformed and com... ...worthless specimens are as well adapted to ...ose as the best shaped. Such of the latter as ...ght up should be left intact, and prepared for ... The raising of sponges by means of the tongs ...the additional objection that the operation can ...med only when the surface of the sea is per... ...ooth. The sprinkling of oil on the surface is ...iently effective for the purpose of rendering it ... Buccich, therefore, devised a simple apparatus, ...ed as follows:—A tin box, 32 c.m. (12½ in.) ...as a glass plate fixed in the bottom; on placing ...n the surface of the water, the bed of the sea ...visible. [The Greek sponge-fishers make use ...nc cylinder, 37 c.m. (14½ in.) in diameter, ...c.m. (19½ in.) high, with a glass plate in ...m, and sink it half-way in the water. The ...nd pearl-fishers in the Bahamas and Panama ...closely similar apparatus for a like purpose.] ...h found that it was not judicious to throw the ...gathered from time to time into one common ...e, there to await the cutting operation, as they ...dily took injury, by the pressure and by the ...ogether. He therefore adopted the plan of ...em temporarily, with wooden pegs, to the inner ...sort of fish-basket, fastened to the tow rope ...at whence the fishery is being prosecuted. If ...nge is injured, the damaged portion must be ...y; the rest is pegged up, either in its entirety, ...cut into pieces.

...ow temperature in the cold season of the year, ...ible, with sponges freshly caught on the spot, ...d at once to make cuttings from them; whilst ...warm weather, it is necessary to wait and see ...any signs of putrefaction make their appear... ...his reveals itself by the dullness and softness of ...ted part. When it happens, further observa... ...eded, after cutting off the diseased portion, to ...whether the putrefaction has spread. Small sponges are usually totally destroyed when once attacked; in large ones, a limit may sometimes be set to the mischief.

The dissection is rapidly performed, either with an ordinary knife, or, as Buccich found, better with a fine saw-like blade, which is much less liable to injury by the foreign matters so abundantly found in sponge. The sponge is laid upon a smooth wooden board, moistened with sea-water. The size of the cuttings is usually about 26 c. mil. (1 cubic inch). It is well that each cutting should have the greatest possible area of uninjured outer skin. The cuttings are placed directly in the spots where they are intended to resume growth.

A healthy piece of sponge firmly attaches itself to any surface with which it comes into intimate contact in a short time. Cut sponges grow together again. The attachment takes place most rapidly when the pieces have but one cut surface, and this is laid upon the support—wood, stone, &c. During perfect calm, for at least 24 hours, it is possible, according to Buccich, to plant the cuttings upon the stony sea-bottom itself, and they will hold. He saw pieces that were merely cast into the sea on an ordinarily suitable rocky bottom, during perfect calm, attach themselves and grow. Thus enlightened as to the natural habits of the sponge, Buccich prepared stone slabs, 53 mm. (2 inches) thick, as a foundation. These he perforated with holes, and fastened the cuttings to them by wooden pegs driven into the holes; but it became evident that the mud and sand of the sea-bottom, perhaps also excess of light, were inimical to further growth, and the necessity for preventing or minimising these two evil influences has been shown by all experience. Preference will always attach to stone as a foundation, it being the natural ground, cheap, and not attacked by the teredo. Originally Prof. O. Schmidt employed perforated wooden chests, on whose inner side, the cuttings were fixed by means of metallic or wooden tacks. This extremely simple arrangement was found unsatisfactory, as the chests, when sunk in the sea, became filled with sand, and the holes got stopped up and ceased to admit light. The sponges acquired a white sickly look. The attaching of the cuttings by metallic pegs is objectionable; all cuttings thus treated were much slower to resume growth than those pegged with wood. The rust which soon forms on the metallic nails prevents the sponge from taking a firm hold, so that the immediate portion, and possibly the whole cutting, is ruined. Lattice frames, having the form of floating tables above, and with the sponges attached beneath, have also been tried. Professor O. Schmidt also suggested merely tying the cuttings to strong suitable strings. By the first plan, there was too much shade; by the second, too much light; and possibly some mischief was done by the fine matters drifted over the surface of the sea, and accumulated as a deposit of the compound vaguely known as "dirt." Buccich first constructed an apparatus composed of two planks crossing each other at right angles, with a third plank as a cover. This was so far successful that the cuttings were exposed on all sides to the action of the sea, and assumed the desirable round form. He then made a modification of this apparatus, consisting of two boards, 63 c.m. (24½ in.) long, and 40 c.m. (15¾ in.) broad; one forms the bottom, and the other the lid, and they are held parallel one over the other at a distance of 42 c.m. (16½ in.) by two short stays, some 11 c.m. (4¼ in.) apart. In the space between these stays, stones can be placed as ballast; on the top of the cover, is a handle. In both planks, holes are bored at 12 cm. (4½ in.) apart, or 24 holes in each. Buccich fastened the cuttings not simply on the apparatus, but on sticks which were driven into the holes of both boards. As material for the sticks, he chose before everything the common Spanish cane, whose siliceous rind is proof against the attacks of the pile-worm. The sticks were 42 c.m. (16½ in.) long, and bored through at distances of

12 c.m. (4½ in.), the lower end being split. On each stick, three sponge-cuttings were fastened in such a manner that they should lie over the bore-holes; through these, wooden sticks were thrust, and each cutting was thus fixed. [It is a matter of great regret that no illustration of these several apparatus was published in the original.]

When the sponge-cuttings are to be pegged only with wooden nails, a triangular stiletto will suffice for piercing the sponge. When adopting the method of fixing by sticks, such an instrument is not suitable, because much too great force would be required to make an opening to admit the sticks. Forcing and squeezing cause a loss of *sarcode*, the minimising of which is the first rule that governs all manipulations of sponge. Buccich bored the cuttings with an auger with toothed edges, 6 mm. (¼-inch) broad, fixed to a vertical wheel, driven rapidly by a little pulley. While one hand quietly presses the sponge against the borer, the other turns the wheel. In a few seconds the operation is concluded. The bore-hole is clean, the fibres are not torn, and the *sarcode* does not run out. When a stick is filled with cuttings, its split end is thrust into one of the holes in the support, and a wedge is driven through the slit. As each bottom and top takes 24 sticks, carrying three cuttings apiece, one such apparatus will accommodate 144 cuttings.

During the whole manipulation, until the arranging of the sponges is quite complete, they must be repeatedly and gently moistened with sea-water, especially in summer. When an apparatus is furnished, it should be sunk at once in warm weather; in winter, as before remarked, a little delay does no harm. The apparatus may be most conveniently let down and pulled up by means of a small anchor. The depth may be 5 to 7 metres (16 to 22 ft.)

The suspension of the apparatus from a support, Buccich does not consider necessary. All woodwork must be well tarred. This is not a perfect remedy, but is the only temporary precaution available against the pile-worm. In the Bay of Socolizza, it was proved that the tarred portions even were destroyed at last. The teredo not only increases the amount of capital necessary for repairing the damaged apparatus, but also depreciates the condition of the cuttings, as the pegs or sticks fall out, and the sponges are destroyed. The most rational mode of procedure would therefore be to avoid wood altogether, and to make use either of stones, with suitable precautions against mud and direct light, or to employ iron in the construction of the apparatus recommended by Buccich.

If the cuttings hold fast after three or four weeks, the propagation is secure. A characteristic feature of the cuttings is their tendency to assume a round form. To facilitate this on every side, is the chief aim of Buccich's system of supporting on sticks. As to the rate of growth of the cuttings within a certain period, no rule can be given, on account of the varying conditions. Buccich remarked that the cuttings in the first year were two or three times as large as they were originally. He further remarked that the cuttings grew better in the first and fourth years, than in the second and third—a point evidently regarded as doubtful by Dr. Marenzeller; and it would seem that though some specimens may have attained a considerable size in the fifth year of transplantation, still a term of seven years is necessary to produce a marketable and profitable article. Dr. Marenzeller also mentions the fact that, besides being beautifully formed and rounded, the cuttings retain these qualities, and perfect health, with increasing size.

In conclusion, Buccich proposes the question whether the undertaking can be made profitable, and answers it in the affirmative. He is of opinion that, with due care in the operations, the cuttings will thrive, and the loss need never exceed 10 per cent., including all contingencies. Taking the cost of the establishment of 5,000 cuttings at about 300 gulden (the gul worth nominally 2s., really about 1s. 8d., or gulden = £25), and the loss at 10 per cent., there a crop of 4,500 sponges at the end of seven the value of which Buccich places at 900 Dr. Marenzeller considers this price far too h the wholesale merchants in Trieste give an ave 8 gulden, and a maximum of 10 gulden per Dalmatian sponge. The sponges must be of co able size, such as will not with certainty be even in seven years. Finally, allowance must b for the fact that the sponges grown on sticks a sidered commercially inferior, and that their v account of the central perforation, is one third l that of naturally grown sponges. The profit seem larger if there were not so long an interval b the outlay and the harvest; in other words, growth of the cuttings were not so slow. years' suspense is a great deterrent. To this added, that in order to maintain a continual pro during the seven years from the commencem annual outlay, equal to the first, is necessary, w apparatus is not so simple that any dweller on t can make it for himself, and wood is not avail reason of the pile-worm. Dr. Marenzeller, theref cludes that the propagation of sponge by cut not to be recommended to people without but is more suited to the attention of talist, or an association of capitalists, and conducted on a large scale. [The great ab money in Austro-Hungary must be borne in weighing this opinion.] It would be a matter encouragement did we possess the knowledge augment the growth of sponge under natural co even though it were no more rapid than in the the cuttings. This being so, Dr. Marenzeller it more than questionable whether it would b tageous to cut into pieces a sponge which, unc have more quickly reached the same size and the collective cuttings, and attention might th stricted to the production of properly round though small, sponges from ill-shaped and com worthless ones. Possibly, also, the production individuals of larger size and better form effected, which, according to Cavolini's exp and in Buccich's opinion, should present no di

BRITISH MUSEUM PRINTED CATALO PRINTED BOOKS.

Another important step has been taken by the of the British Museum in the gigantic task of tu voluminous MS. catalogue into a printed one. catalogue already takes up more room in the Read than can well be spared, and it is calculated t all the MS. entries are superseded by printed the volumes will be reduced in number to abo of what they are at present. Some of the vo now congested with entries, and it has there decided to print these crowded entries in instance. In order to carry this decision into e first portion of the letter B has been print forms a folio part of 191 pages. The first e follows:—

"B *see* A. The Lord's-day, the Sabbath d Digested dialogue-wise between two Di and B, &c., 1636 4to. 4355. b."

The last entry is—

"B. y S., D F. Florinda, escena tragica i [in verse] Por D. F. B. y S. Valencia 1 1342, f. 1 (37)."

It is not intended to continue the printi particular order, but to deal first with those p the catalogue that require re-arrangement on the crowded nature of the MS. entries. It is

›bable that the letter B will be completed at the ; time.

printing of the old slips will not effect the pro- of the catalogue of modern books and new ns which will be continued independently.

NUFACTURE OF MATTING IN CHINA.

United States Consul at Canton reports that the acture of matting is extensively carried on in especially towards the south, where it is one of st important industries engaged in. Enormous ties of matting are made both for export and r home use, much being used as sails on the sailing craft, as it is much cheaper, if not more e, than the ordinary canvas or sailcloth. It is ed as coverings for boxes and packages in which gar, cassia, &c., are exported; also in making bags, it being a very convenient mode of handling , especially when broken up into small pieces by nstant stamping or "chopping" of the dollars, e custom in China. The plant from which the ls, &c., so extensively used in China, is obtained, m as "aquatic grass," also as "rush." It is culti- in the Shuihing department on the West River, eventy-five miles in the interior from Canton. grown in the same way as rice, in fields flooded ater. It requires very little care in its cultiva- s it propagates itself by shoots from the root, and a height of from six to eight feet. It is t to market in bundles of about twelve inches in er, and if of proper length and good quality, t about 10d. per bundle, each bundle being nt to make four bed mats, or six such as are r making sails. The district of Tung Kuan es large quantities of this grass, but of a species most entirely in the manufacture of floor matting. aid to grow better in the vicinity of salt water, the water flooding it is somewhat brackish. It ited usually in the month of June from slips. are allowed to grow for about two months, they are replanted in rows. The soil being ully manured with bean cake, it requires nearly months to mature, when it is cut, the shoots or are split in two with a knife, and, when par- lried in the sun, packed in bundles, and manu- d into matting at the city of Tung Kuan, or t to Canton, where there are several extensive actories. When brought to the factory, the grass fully sorted, it is then made into bundles of two ee inches in diameter, and placed in large earthen- jars, holding about ten gallons of water; it is d to remain thus in soak for three days, when it n out and dried in the sun for a day. If it is yed the ordinary red colour, which has been for much in vogue, it is placed in jars containing d dye, made by soaking red sapan wood chips in . It remains in these jars for five days, then dried lay, afterwards again immersed in the dye for days, when it is usually ready for use. It is only the past two or three years that other colours, s green, yellow, and blue, have been used to any t. The solution for colouring yellow is produced the seeds and flowers of a plant common to , the "hui fà." A yellow colouring matter o made by boiling, for several hours, twenty- pounds of *Sophora Japonica* in one hundred ns of water, and adding, when cooled, one d of alum to each ten gallons of the solution. and blue are produced from the twigs and leaves "lamyip" or blue plant, which grows in abund- near Canton. To the solution thus produced a quantity of chemical dye is now usually added. ing these colours, the straw is soaked in water for days, and then immersed in the colouring matter few hours only, the solution being hot. Consul Lincoln states that in a recent visit to one of the largest manufactories, he found fifty looms being worked, eight of which were large, and forty-two small. The large ones are exactly the same as the ordinary silk loom, and are used in making the very wide, and also the damask or carpet patterns. Three men are required to work each of the large looms, their wages being from 1s. 3d. to 1s. 8d. a day. Eight yards of matting from each loom is considered an average result of a day's work. The small looms are rude and simple, each being worked by two small boys, who are paid from 7d. to 10d. per day each, and who daily weave five yards of most perfect matting of the more ordinary patterns. The loom is composed of two uprights, driven into the ground, about five feet apart, and about four feet in height, two cross-bars fit into sockets in the uprights, one at the top, the other about eight inches from the ground. The warps, which are strings of Chinese hemp, two yards and a-half in length, are then passed over the upper, and round beneath the lower cross-bar, through the holes in the weaving-bar, and, being drawn taut, are fastened by both ends to a long, thin piece of bamboo, placed parallel with, and just below the lower cross-bar. The weaving bar, and the most important part of the loom, consists of a piece of wood, varying in length according to the width of the matting required, and about two inches square; through this, small holes are pierced at different intervals, into which the warps are passed; the bar can thus be worked up and down in the warps by means of handles near the extremities—these holes vary in distance from each other according to the pattern desired—alternately on top and bottom. The holes are enlarged, or formed into slots, converging at the centre of the stick. When the warps have been thus arranged, and bundles of different coloured straw, sufficiently damp, deposited near the loom, one of the boys raises the weaving bar to the top of the warps, tipping it forward, the slits in the bar allowing the alternate warps to remain per- pendicular, the holes carrying the others forward, thus separating them sufficiently to admit of a single straw being passed between them. This is done by a long flat piece of bamboo, a notch being cut near the end, into which one end of the straw is placed, and then used as a shuttle. When the bamboo is withdrawn, the weaving bar descends, carrying the straw to the bottom; the bar is then raised again and tipped down, thus carrying the warps backward which had just before been passed forward, the work of the shuttle being repeated. As the weaving bar presses the straw down, the weaver gives the ends of the straw a half-turn round the outside warps, the operation being repeated until the warps are full, the edges trimmed, the warps untied, the matting now two yards in length removed, and a new set of warps put on. The matting thus woven is then dried in the sun, and over a slow fire. The shrinkage consequent on this drying is nearly four yards in forty. When dried it is stretched on a frame and worked down tight by hand, then sent to the packing-house, where men are engaged in fastening the two yards lengths together, it requiring twenty lengths to make the ordinary roll. The fastening together is done by taking the projecting ends of the warps of one piece, and by means of a large bamboo needle, passing them backwards and forwards through the reeds of another piece, in fact, sewing them together; each roll of forty yards is then carefully covered with a coarse, plain, straw mat, marked and numbered ready for ship- ment.

OOLACHAN OIL A SUBSTITUTE FOR COD LIVER OIL.

Under the above name a new medicinal oil has lately been introduced to English commerce. It is said to so closely resemble cod liver oil, both in appearance and

therapeutic ffect, as to be scarcely distinguishable from it. This new oil is obtained from a fish which is found on the coast of Vancouver's Island and British Columbia, as well as in the bays between the Frazer and Skena rivers. It is known to the North American Indians as the Oolachan or Candle fish, this latter name being derived from the fact that, in a dried state, it is used by the natives as a torch or candle, on account of the large quantity of oleaginous matter it contains. The fish is described as being about the size of a herring, and in habit similar to that of the salmon; ascending the river once a year to spawn, it remains only for a very short period, sometimes not more than a day, and, as it can be caught only at these times, the manufacture of the oil is somewhat precarious.

As a food the fish is highly valued by the Indians, by reason of the delicacy of its flavour, and it is also esteemed by them for its medicinal virtues. As a medicinal the oil has already established a reputation in America as a valuable substitute for cod liver oil, and it is believed that when it becomes better known in this country it will take a high position with us.

GENERAL NOTES.

Paper Belting.—It is reported in *Engineering* that paper belting is successfully used in the machinery-hall of an exhibition now being held in Japan. The Japanese have long been celebrated for their manufacture of some exceedingly tough descriptions of paper, and it is stated that the paper belting has been tested and found much stronger than ordinary leather. Now that machinery is rapidly making its way into Japan, the manufacture of this paper belting is of special interest to the country, as from the want of proper tanning good leather is not made by the Japanese.

A New Gum.—Mr. Thomas Christy, F.L.S., of Malvern-house, Sydenham, writes:—"I have received a case of gum, or resin, which is treated after being taken from the *Pistacia terebinthus* tree, and by boiling, the gum is extracted from the resin. This resinous substance is employed in more than one way in the East, viz., for glazing printed calicoes, and in some preparations it renders the cloth waterproof. It is also used in bookbinding, and for sticking paper together, as water has no effect upon it. I shall be very glad to distribute samples to those who care to try experiments with it, if they will promise me their results."

Glass Sellers' Company.—The Court of the Worshipful Company of Glass Sellers, have given notice that they are prepared to award a sum not exceeding £110 in prizes, for essays on the "Past and Present Position of the Glass Trade," as follows:—£50 for an essay on the "Glass Trade in all its Branches;" £20 for an essay on the "Trade in Crown, Sheet, Plate, Rolled, and Cathedral Glass;" £20 for an essay on "Flint and Pressed Glass;" and £20 for an essay on "Bottle Glass." Competitors will be expected to consider the present state of the trade, as compared with its condition in foreign countries. The Court, however, are not desirous of inducing the writers to prepare historical notices of the trade, and they would prefer that the writers should deal with historical matters only, so far as they bear upon the present state of the British glass trade. The essays must be sent in not later than the 31st January next, to the Honorary Clerk, at the office, 58, Gracechurch-street, E.C., from whom further particulars can be obtained.

MEETINGS OF THE SOCIETY.

FOREIGN AND COLONIAL SECTION.

Tuesday evenings, at eight o'clock:—

MAY 31.—"The Principality of Loo Choo." By Consul JOHN A. GUBBINS. Sir HARRY PARKES, K.C.B., H.B.M.'s Minister in Japan, will preside.

CANTOR LECTURES.

Monday evenings, at eight o'clock:—

The Fifth Course is on "Colour
and its Influence upon Various Indu
R. BRUDENELL CARTER, F.R.C.S. Thre

LECTURE III.—MONDAY, MAY 3
Industries chiefly affected by colour
Engine-drivers, pilots, artists, letter-sorte
painters, &c., &c. Recent legislation affec
blindness in America, and urgent need fo
country. Conclusion.

MEETINGS FOR THE ENSUING W

MONDAY, MAY 30TH...SOCIETY OF ARTS,
Adelphi, W.C., 8 p.m. (Cantor Lectu
Brudenell Carter, "Colour Blindness, and
upon Various Industries." (Lecture III.)
Institute of Surveyors, 12, Great George-
8 p.m. Annual General Meeting.
Asiatic, 22, Albemarle-street, W., 4 p.
Meeting.

TUESDAY, MAY 31ST...SOCIETY OF ARTS.
Adelphi, W.C., 8 p.m. (Foreign and Colo
Consul G. A. Gubbins, "The Principality
Royal Institution, Albemarle-street, W.,
Dewar, "The Non-Metallic Elements."
Central Chamber of Commerce (at the H
SOCIETY OF ARTS), 11 a.m.
Civil Engineers, 25, Great George-street,
S.W., 8 p.m. Mr. Richard Henry Br
Production of Paraffin and Paraffin Oil."

WEDNESDAY, JUNE 1ST...National Health Society (
OF THE SOCIETY OF ARTS), 7.30 p.m.
Hellyer, "The Science and Art of Sanitar
(Lecture II.) Joints and Pipe Bending.
Entomological, 11, Chandos-street, W., 7 p.
Public Analysts, Burlington-house, W., 8
General Meeting for the consideration of
the Valuation of Impurities in Drinking
has been in partial use by some of the Me
Society who are co-operating in the sche
analyses. The subject will be introduce
by Mr. Wigner.
Archæological Association, 32, Sackville-
p.m. 1. Mr. H. Syer Cuming, "Mermai
S. M. Mayhew, "Articles found in Londo
Obstetrical, 53, Berners-street, Oxford-stre

THURSDAY, JUNE 2ND ... SOCIETY OF ARTS.
Adelphi, W.C., 8.30 p.m. *Conversazione*
Kensington Museum.
Antiquaries, Burlington-house, W., 8½ p.m.
Linnean, Burlington-house, W., 8 p.m
Lubbock, "The Habits of Ants" (viii.
Ridley, "The genus *Plocamia*, Schmidt,
other Sponges of the order Echinonema
Duncan, "*Diropalum*, a new genus of Spo
Chemical, Burlington-house, W., 8 p.m.
H. Allen and W. Thomson, "The Sap
Fatty Oils and Waxes." 2. Mr. Spen
"The Sulphides of Copper, and a Dete
their Molecular Weight."
Society for the Encouragement of Fine Art
street, W., 8 p.m. Musical Lecture, by
Gilbert.
South London Photographic (at the Ho
SOCIETY OF ARTS), 8 p.m.
Royal Institution, Albemarle-street, W.,
Tyndall, "Paramagnetism and Diamagne
ture VI.)
Royal Society Club, Willis's-rooms, St. J
6 p.m.
Archæological Institution, 16, Burlington-str

FRIDAY, JUNE 3RD...National Health Society (at the
SOCIETY OF ARTS), 7½ p.m. Mr. S. Ste
"The Science and Art of Sanitary Plumbi
tion of Lecture I.)
Royal United Service Institution, Whitehall
Captain J. R. Lumley, "Mounted Infantry
Royal Institution, Albemarle-street, W., 8 p
Meeting. 9 p.m. Prof. W. G. Adams, "
turbance—Auroræ and Earth Currents."
Geologists' Association, University College,
Philological, University College, W.C., 8 p.
Swift, "Some Points in English Grammar."

SATURDAY, JUNE 4TH ... Physical, Science Schools, Sou
ton, S.W., 3 p.m. 1. Prof. Poynting, "Th
State from Solid to Liquid." 2. Mr. C. J.
"Illustrations of Fresnel's Theory."
Royal Institution, Albemarle-street, W., 3 p.
E. Turner, "Russian Literature." (Lectu
Institute of Actuaries, The Quadrangle, Ki
W.C., 8 p.m. Annual Meeting.

. OF THE SOCIETY OF ARTS.

No. 1,489. Vol. XXIX.

FRIDAY, JUNE 3, 1881.

tions for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

CANTOR LECTURES.

d and concluding lecture of the fifth "Colour Blindness, and its Influences ous Industries," was delivered by R. Carter, F.R.C.S., on Monday, 30th ult. was drawn to the industries chiefly colour blindness, and the dangers and nces consequent on the defect in the ngine-drivers, pilots, artists, letter pers, painters, &c. The lecturer alluded nt legislation in the United States, and t the urgent need for legislation in this

IRMAN (Dr. Mann, F.R.C.S.), in moving ote of thanks to Mr. Brudenell Carter teresting and instructive course of ew attention to the curious fact that nportant defect of the human eye—one ith the most serious dangers—should been discovered within a comparative od. He thought, in listening to these the remark of Helmholtz, that among able scientific discoveries of the present which related to the domain of were, perhaps, the most remarkable. ures will be printed in the *Journal* autumn recess.

MEMORIAL TABLETS.

he past month new tablets have been six houses to commemorate the resi- em of the following celebrated men :—

r—36, Castle-street, Oxford-street.
garth—30, Leicester-square.
has been rebuilt for Archbishop Tenison's

wton—35, St. Martin's-street.
eat—15, Buckingham-street, Strand.
nsley Sheridan—14, Savile-row.
Valpole—5, Arlington-street.

The following is a list of tablets previously erected by the Society of Arts :—

Burke—37, Gerrard-street, Soho.
Byron—16, Holles-street, Cavendish-square.
Canning—37, Conduit-street.
Dryden—43, Gerrard-street.
Faraday—2, Blandford-street, Portman-square.
Flaxman—7, Buckingham-street, Fitzroy-square.
Franklin—7, Craven-street.
Garrick—5, Adelphi-terrace.
Handel—25, Brook-street.
Johnson—17, Gough-square, Fleet-street.
Napoleon III.—3A, King-street, St. James's.
Nelson—147, New Bond-street.
Reynolds—47, Leicester-square.
Mrs. Siddons—27, Upper Baker-street.

DOMESTIC ECONOMY CONGRESS.

Her Royal Highness the Princess Christian, President of the Congress, took the chair at the meeting of the Ladies' General Committee, held on Wednesday, 1st inst., in the Great Room of the Society of Arts. The following ladies attended :— The Countess of Airlie, the Countess Spencer, Lady Arthur Russell, Viscountess Strangford, Lady Marion Alford, Lady Jane Stewart, Lady Charlotte Schreiber, Lady Reay, Dowager Lady Stanley of Alderley, Lady Knightley, Lady Cole, Lady Clive Bayley, Lady Hogg, Mrs. Bartley, Mrs. Burke, Mrs. Russel Carew, Mrs. Charles, Mrs. Cotton, Mrs. Dacre Craven, Mrs. Cromwell, Mrs. Fowke, Mrs. Grenfell, Mrs. Hollond, Mrs. Lecky, Mrs. Mann, Mrs. Fenwick Miller, Mrs. Peploe, Mrs. Price, Mrs. Priestley, Mrs. Seeley, Mrs. Stansfeld, Mrs. Tubbs, Mrs. Webster, Miss Rose Adams, Miss Andrews, Miss E. Barnett, Miss Cole, Miss Gurney, Miss Hamonds, Miss M. Hooper, Miss Fay Lankester, Miss H. Martin, and Miss Stanley. Sir Henry Cole, Lord Alfred S. Churchill, and the Rev. Newton Price, members of the Executive Committee, were also present.

PRACTICAL EXAMINATION IN VOCAL OR INSTRUMENTAL MUSIC.

The next Examination in London will be held by Dr. Hullah, the Society's Examiner, at the House of the Society of Arts, 18, John-street, Adelphi, W.C., during the week commencing on the 4th July, 1881.

The examination of each candidate will be private; no one but the Examiner and the accompanyist being present, unless it be a member of the Society of Arts' Committee.

No list of Candidates will be published.

Full particulars can be obtained on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

FOREIGN AND COLONIAL SECTION.

Tuesday, May 31, 1881; Sir Harry Parkes, K.C.B., H.B.M.'s Minister in Japan, in the chair.

The Chairman, in calling upon the Secretary of the Section to read the paper, said he regretted that Mr. Gubbins was not present to read the paper, being obliged to absent himself through ill-health—the same cause which had brought him home to England for medical aid. The position of this little kingdom in the Pacific was very curious, on account not only of its antiquity and of its advances in civilisation, but also of the very peaceable and excellent disposition of its inhabitants. We, in England, had little acquaintance with these islands, as they lay rather out of the ordinary routes of commerce, but Englishmen had landed there occasionally for more than sixty years; and whenever a foreigner had done this, he had been struck by the cordial reception he met with. About four years ago he (the Chairman) had occasion to visit the islands, and one of the first things he was shown was the grave of a seaman belonging to his Majesty's ship *Alceste*, who was buried there in 1816. The tomb was kept up with great care, and the inscription was almost as legible as the day it was cut. Of course he expressed his gratitude for the care which had been bestowed on the grave of a fellow countryman. Although this little State had had its own autonomy for many centuries, it had lately been the subject of a political question between the empires of China and Japan, to both of which it had been accustomed to pay tribute. This could hardly be expected to continue indefinitely, and Japan had lately made special claims, and annexed the whole islands, so that Loochoo had, in fact, now ceased to exist as an independent principality.

The paper read was—

NOTES REGARDING THE PRINCIPALITY OF LOOCHOO.

By John A. Gubbins, of the Consular Service.

A common mistake made by foreigners in China and Japan is to suppose that the principality of Loochoo—which, for several centuries, has existed as a tributary State, owing allegiance both to China and Japan, but at the same time governed by her own laws, and having her own peculiar manners and customs—includes the whole of those islands known to navigators as the Loochoo group. The northern islands of this group, however, of which the principal are Oho-sima, Yarabu-sima, and Kikai-sima, have been Japanese possessions for nearly three hundred years, and at a comparatively recent date another small island was added to the list.

Loochoo proper consists of the large island of Okinawa-sima, and nine outlying groups. There are besides smaller islands, more or less distant, which are too numerous to mention in detail.

According to statistics obtained on the spot, the total population of Loochoo in 1875 was 165,930, divided as follows:—Main island—Shizoku, 29,633 men; 29,722 women. Heimin, 28,980 men; 28,981 women; total, 117,31… islands of which the Miyako group co… half, 52,495, the proportion of wo… slightly in excess of the men.

The population of the main island … equally distributed, more than half of wh… of inhabitants being included in the … which are also distinguished from th… country by the fact that the populat… posed almost entirely of Shizoku. The … Okinawa has three large geographical … which are subdivided into thirty-five Ma… districts, that are again divided into m… villages.

Class Distinctions and Nobility.

The people of Loochoo may be roughly di… into two classes—Shizoku and Heimin—… tinction borrowed from Japan. The king, … course, the head of the State. Next to … rank come:—1. Nobles of the first rank an… grade. This class comprises the uncles, br… and sons of the king, who have the title … 2. Nobles of the first rank and second … This class comprises all the other relations … king, who have the title of Andzu. The … the nobility then follow in the order given … —Second rank, first and second grades, … (the "Sandzukwan," or Thruknia Oyak… virtue of their position take rank with the … Third rank, first grade to sixth rank, … grade, Paikin. Seventh rank, first grade, S… Paikin. Seventh rank, second grade, C… Paikin. Eighth rank, first grade, S… Eighth rank, second grade, Wakazatonosh… rank, first grade, Chikudon. Ninth ran… grade, Chikudon Zashiki. No rank o… Zashiki. These titles are quite indepe… official designations; they are not n… hereditary, and are conferred on indivi… services rendered to the State.

Government Departments and Off…

The King of Loochoo is nominally at … of the Government, but his share in th… administration is very small. All affairs … are carried on by officials chosen from a… nobility, at the head of whom is the … Prime Minister, who is selected from the … of the blood, or, failing such, from th… relatives. It may, indeed, be said that th… who presides over the Council of State, … Sandzukwan divide the heaviest responsib… Government between them.

Some idea of the system of Governmen… gathered from the following list of public … ments and the officials attached to them:—

Hiôjô-sho, or Council of State, which … superintendence of all important busin… alone has power to decide matters of St… this are attached the Prime Minister … Sandzukwan (who are not chosen by th… but by the general vote of the leading offi… nobles). The rest of the staff is made … Head Secretary and six Under Secretari… of the Sandzukwan has charge of th… Department, and the control of matt… nected with mountains; another has cha…

* This term is evidently taken from an old land… Satsuma, called Magiri.

epartment, and the control of matters h rivers. These two serve alternately ı at a time. The third has charge of)ffice, and the control of districts and

sho, or Home and Finance Depart- ıree sub-departments, viz. (1) Finance ontrol over receipts and expenditure :h the productions of various districts (2.) Salary Office; (3.) Office where gency, such as landslips, inundations, with.

i-ho, or Foreign Office. The duties are—(1.) Conduct of relations with rs; (2.) Distribution of rewards and

Judicial Department, with a staff of irato-to-soba, and two Gimi. Sho-)artment of Ceremonies; Kin-jiu-ho, ousehold; Kei-dzu-za, or Herald's o-za, or Registrar's Office; Jisha-za, Religion; Yobutsu-za, or Chinese artment; Tachi-ho, or Board of Yamabugiô-sho, or Department of Forests; Fushinbugiö-sho, or Public tment; Shi-josé-za, Office for Control Tribute, and other business connected

the principal Government Depart- ould be too tedious to go through the f minor offices. The most trivial r to have separate offices for their con- g others are—the O-dai-dokoro, or n; the Rionza, or office for super- e preparation of food for banquets hinese delegates and other foreign nt in Loochoo for the time being; the r Government stables; the So-yo- Board for supervision of the manners of the people; and the Kawara-bugiô- for controlling the manufacture of roofs of houses.

duty of collecting the revenue, and of receipts and expenditure, are ıgst six or seven different departments. above-mentioned offices, each district), or local office, and to each of these one Jito, or lord of the manor, one ıe Shiuri-Yako, one Osabakuri, one ri, and several Sabakuri, the number ot fixed. The first three are appointed and are not natives of the district. ffices are filled by local men. The administer the islands of Miyako and are—one Zaiban, or Governor, three three to five Oyako, and several sub- cials.

e case of the districts, the officers rade of Oyako are local men. There ials called Yénin, detached for foreign an.

hima there has been a Loochooan r since the conquest of Loochoo by 1610, and Oyakata and other leading reside in it. Since 1868, however, the been called the Kura-Yashiki, and e Home and Finance Department have a term of one year at a time, their ng to superintend the purchase of e Han. Although in the time when tribute was paid to China, a resident interpreter was attached to the Loochooan factory at Foochow, there was never a regular foreign service similar to that adopted in the case of Japan.

The laws of Loochoo include, in addition to a Civil and Penal Code, a complete set of regulations concerning the distribution of rewards. One or two instances will suffice to illustrate the character of these rules:—

Rewards (including increase of rank, official appointments, and presents of goods) are given to persons who promote the interests of agriculture in various ways, which are detailed; who have made themselves conspicuous by deeds of charity and benevolence; who give assistance in cases of famine and shipwreck; who attain the age of 100 years; to officials who lessen official expenditure; who improve the Government finances by inaugurating reforms of various kinds; to women who show great respect to their husband's parents; and to widows who remain single.

With regard to the Civil Code I have been unable to gain any information.

The Penal Code of Loochoo is based on the laws of China, and the ancient laws of Satsuma. It is remarkable for its simplicity and severity, and the influence of Confucianism may be clearly traced. I understand, however, that the penalties laid down were by no means strictly enforced. By order of the Japanese Government the Loochooan criminal code was lately abolished, and Japanese criminal law has taken its place. Still, in spite of the fact that these laws have ceased to exist, the following short notice of them may not be without interest.

Offences in respect to parents, ancestors and relations, ranging from murder down to simple assault, were punished with crucifixion, decapitation, or banishment, according to the gravity of the crime. The murder of a husband by his wife, was punished with crucifixion. Murder in other cases, forging the Government seals, opening or rifling graves, burglary, accompanied by manslaughter, and other personal violence, with decapitation. Bribery, libel, the profession of Christianity or other religion not recognised in Loochoo, adultery, theft of official money, entering the castle without permission, and gambling (second offence), were punished by banishment—in some cases to uninhabited islands.

Violence offered to people by persons under the influence of drink was punished—In the case of Shizoku, by confinement in temple buildings; in the case of Heimin, by flogging and imprisonment; in the case of officials, by dismissal. Taking a man's wife and children in pledge for money lent was a punishable offence, but did not come under the head of grave crimes. Those also who charged a higher rate of interest on money lent than 20 per cent. per annum were punished. Two things are brought out very clearly by these laws—namely the subordination of a wife to her husband, and of the Heimin to the Shizoku.

REVENUE AND EXPENDITURE.

On this subject I obtained the following information from the Home Office Secretary, resident at Nafwa. The yearly assessment of cultivated lands in Loochoo, is fixed at 94,233 koku of rice, of which 75,134 koku are contributed by the

main islands, and of balance by the adjacent islands in the jurisdiction of the Han.

The taxes in Loochoo may be divided into two kinds—seizei, or regular taxes, and zatsuzei, or miscellaneous taxes. The seizei, or regular taxes, form the revenue of the Government, and consist of rice, 21,580 koku; sugar, 2,048,239 koku (probably catties); other cereals, 5,379 koku; millet, 4,877 koku; cash, 2,705,768 kwan = yen 48,115^{73}. As against this, the Government expenditure is as follows:—Tribute paid to Japan, 11,122 koku of rice. Office expenditure—Rice, 5.171 koku; other cereals, 4,066 koku; cash, 31,187,720 kwan = yen 623,754^{40}. Expenditure of King—Rice, 1,046; incomes of Han retainers—Rice, 2,867 koku. Officials' salaries—Rice, 3,113 koku; other cereals, 2,027; cash, 285,563 kwan = yen 5,711^{26}. The miscellaneous taxes (zatsuzei) are local taxes paid by the people of the various villages and districts to the lords of the manor (jito and wakijito). With regard to these Mr. Kinashi, the resident secretary of the Home Office, informed me that in spite of repeated efforts, he had found it impossible to obtain reliable statistics on the subject. These taxes, it appears, are not fixed, but vary in each village, according to the quality of the soil, and the number of inhabitants, and the amount to be collected is left very much to the discretion of the local lord of the manor. Charcoal and firewood are included under the head of this indirect taxation, and I ascertained that it is in the power of the jito to levy the taxes due to him in any form which suits him. Thus, if he wishes to lay in a stock of fuel for the winter, he may demand to be supplied with charcoal and firewood to the amount necessary for his use, and, instead of paying for it at the time, he may subtract the value of the supplies furnished from other taxes due to him. He may also employ labour to any extent which he may think fit, the wages of the people employed serving as a set-off against the taxes to be collected from them. It is obvious that under such a system as this the greatest injustice can be committed. To a man who earns his hiring from day to day, it is the greatest hardship to be taken from his daily employment, and be compelled to do work, the payment of which is deferred to an indefinite period. In such a position the labourer becomes little better than a slave.

Productions of Loochoo.

According to a table of statistics (which is compiled from native sources), kindly furnished to me by the Japanese Home Office authorities at Nafwa, the value of the total exports from Loochoo to Japan during the year amounts to* yen 241,300, as against imports to the extent of yen 121,800, leaving a balance in favour of the islands of yen 119,500.

Imports.—The imports from Kagoshima, which serves as the port of connection between Japan and Loochoo, are:—

	Yen.
Rice	30,000
Beans	3,400
Rapeseed Oil	5,000
Tea	1,200
Lacquer	1,300
Tobacco	4,000
Vermicelli	9,500
Raw cotton	8,400
Thread (cotton)	26,600
Miscellaneous, including dried fish, saké, seaweed, hair-oil, timber, iron, iron-ware, hardware, and foreign goods (about)	16,900
Total	Yen 121,800

The above figures do not include some mis[illegible] items, the returns for which have not bee[illegible] obtained; and in the case of each item, it mus[illegible] be borne in mind that the figures represent onl[illegible] the approximate annual amount.

Exports (principally to Kagoshima).—Sug[illegible] figures, of course, as the chief item, the avera[illegible] yearly export of this article being 6,500,000 catti[illegible] representing an approximate value of yen 162,50[illegible] or more than two-thirds of the total value of th[illegible] exports.

Statistics are wanting in the case of the oth[illegible] articles, but they may be roughly estimated [illegible] follows:—

	Yen.
Cotton cloth	28,000
Hempen cloth	12,500
Other cloth	7,200
Tenmugi (silk fabric)	2,800
Yellow dye (ukon)	900
Loochooan saké (awamori)	2,500
Medicinal drugs	2,700
Salted pork	2,300
Umbrellas	950
Rope	650
Miscellaneous	18,300
	78,800
Add sugar	162,500
Total	Yen 241,300

The exports above mentioned naturally affo[illegible] an indication of the principal productions of th[illegible] country. But there are other productions, whic[illegible] for obvious reasons, do not figure in the list [illegible] exported goods. Under this head come

Potatoes.—Which may be regarded as the stap[illegible] food of the islands.

Rice.—Which gives two crops, one grown in th[illegible] spring and one in the autumn, yielding so[illegible] 32,000 koku.

Indigo.—Used everywhere as a dye, and gro[illegible] by individuals for private use.

Peas and Beans.—Both Japanese and forei[illegible] varieties, the latter having been introduced wit[illegible] the last 60 years. Capt. Hall, in his "Voy[illegible] and Journal," speaks of having given [illegible] seeds of various English vegetables to the Lo[illegible] chooans, and adds that they were instructed h[illegible] to grow them. The date of his visit, in H.M.[illegible] *Lyra*, to the Loochooans—1816—corresp[illegible] with the date of their introduction as mentio[illegible] to me by the natives.

Millet.—

Palms.—Which are grown extensively under the superintendence of the Government, in order to [illegible]

* In the case of exports, the exchange between Loochooan and Japanese currency is taken at 50 kwan to the yen, this being the rate ruling at the Port of Nafwa. In the case of imports, the Kagoshima rate of exchange, 32 kwan to the yen, has been adopted. If the same rate be taken for the imports as for the exports, the total value of the former will reach yen 140,000, thus greatly reducing the balance in favour of the islands.

esource in times of famine, the heart of ng eaten.

Horses, bullocks, pigs, and goats). er is obliged to keep three or four pigs · the sake of the manure which is thus ıould he fail to do so, a money payment

This production, to the growth of which .s owe whatever commercial importance ɜ, is stated to have been introduced into om China in the year A.D. 1623. At ɔrms by far the most important product ds. I was unable to procure statistics ıge yield of the year, although, judging ımber of Government offices which are ın the cultivation of sugar, and in its ıs a portion of the revenue, the most 'ormation in this respect ought to be In former years the trade in sugar ɔochoos was in the hands of the Satsuma it is doubtless in part owing to the f this lucrative monopoly that Han ɔh a flourishing condition. The sugar ı conveyed to Kagoshima, from the a large proportion—that coming from and Yarabusima—being actually the the Han), and thence it was sent by ɹnk to Osaka, where it was sold in y the Satsuma agents at the Yashibi of the highest bidders by written tender. .nts who purchased it then retailed it to lers, and it was in this way gradually to different parts of the country. It is hat the value of the sugar which used ɔugh the hands of the Satsuma autho- ot less than yen 500,000. This estimate, ıdging by the present export of sugar oo proper, seems to be rather large. Of since the abolition of the Han, the sugar ıught by private merchants and trading at Kagoshima and Osaka, and no r the trade is exercised by the Govern-

r plantations are owned by private land- ı proprietorship not being restricted to Each proprietor has his own sugar niently near to the plantations. These very primitive construction. Imagine pace some 30 feet in diameter. In the is are three cylindrical rollers arranged :de by side. The centre roller is higher 'o others, and is turned by means of a 'astened to the top of the roller, and to a pony or bullock, who moves along a ːh on the outer edge of the enclosure. f simple cogs, made so as to fit one into ıe centre roller turns the two others. fed by two men, who sit one on each ıch cane is crushed twice, being passed ıtween the centre and the right hand passed back again between the centre he roller on the left. The juice, as it l, falls into a trough underneath the ırough this it runs into a tub, which, s emptied into the ovens close by. s are round, open at the top, and built Each is protected from rain and wind ıed roof, which also affords shelter to ıo attend to the fire. The process of boiling the sugar is simple enough. Before lighting the furnace below, three shallow iron pans are arranged in the oven, in the form of a trefoil, and the spaces between them and round the side of the oven are built up with a mixture of clay and straw. The liquid sugar is then poured into the pans, and, the furnace being lighted, is allowed to boil five or six hours. During this operation, the burnt ash of a stone collected on the sea-shore, is mixed with it in definite proportions. When the sugar is sufficiently boiled, the pans are removed, and placed in the open air. Here the sugar is stirred until it becomes cool, and it is then poured into tubs, where it forms a solid cake. Each tub holds about 120 catties. Sugar is conveyed by coolies from the plantations to Nafwa, whence it is exported to Japan. The boiling season is during the cold weather, from November to February.

Foreign Intercourse.—Relations of Loochoo with Japan, China, and other Foreign Powers.

The ancient history of Loochoo is enveloped in mystery, and its earliest historical traditions bear a resemblance to those of its larger neighbour, Japan. Considering that the first native history of Loochoo, the "Chinzan Sekan," was not compiled till the year A.D. 1650, the legendary character of these traditions is no matter for surprise; but the claim upon our credence passes all reasonable bounds.

We are asked to believe that the dynasty, of which the first ruler was a mythical personage known to posterity as Tensonji, existed for a period of 17,800 years, ending in A.D. 1190. In the latter year, a new dynasty was founded, according to Japanese accounts—which the Loochooans are far from accepting as fact—by a Loochooan of Japanese descent, under the following circumstances:—

In the spring of the year 1165, Minamoto Tamétomo, who had been living for some years in retirement in Oho-sima, whither he had been banished after the defeat of his family by the rival house of Taira, took ship and sailed westward in search of adventure. After a voyage of long duration, he arrived at the harbour of Unten, in the extreme north of the main island, Okinawa. He was received kindly by the Loochooans, and stayed on the island for seven or eight years, during which he gained the friendship of one of the local potentates, Ufuzato no Andzu, the lord of the district of Ufuzato, and married his daughter. Two years after the marriage his wife bore him a son, who, in 1190, succeeded to the Loochooan throne, taking the name of Shunten. The reasons given for his succession are briefly as follows:—The twenty-fifth of the old line of Loochooan kings was a man of feeble character, who allowed the administration to fall into a state of complete disorder. His misrule led to a revolution, in which he was deposed and killed by a powerful noble, named Rin, who seized the throne. But the latter was in his turn deposed by the son of Tamétomo, who, left in Loochoo as a child of six years of age, when he returned to Japan, gave evidence of so much ability as he grew up that, at the early age of 15, he was made lord of the district of Urasoyé. He was only 22 years of age when he ascended the Loochooan throne. Tamétomo is said to have instructed his son in the Japanese

syllabarics, and the latter is credited with their adoption in Loochoo.

There are several Japanese works (also one, if not more, Chinese books) which contain accounts of Loochoo, and in which mention is made of the intercourse which has taken place in past centuries between Loochoo and foreign countries. From a summary of extracts from these works, which are given in the "Okirawa Shi" (a recent work on Loochoo, written by a Japanese), it appears that the Japanese claim to have received tribute from Loochoo as early as the year A.D. 616, in the course of which several Loochooans arrived in Japan. Tribute was not then paid regularly, and consisted of articles of little value, principally palm-wood. The fragment of this tribute—if the occasional presents which marked the existence of friendly relations between the two countries may be called by that name—continued up to the year, A.D. 754, when the Empress Koken was on the Japanese throne. From that time till the year A.D. 1610, intercourse between the two countries appears to have ceased. It may be that the Japanese Government advanced claims to suzerainty which the Loochooans declined to admit. However, in the latter year, Loochoo was invaded and conquered by the Satsuma clan. The first attempt made by the Satsuma force to land at Nafwa was repulsed, and the invading force consequently landed at Unten, the northern harbour. The campaign is said to have lasted only 40 days.

The tribute then assumed a definite shape, the amount payable yearly to the Satsuma Treasury being between seven and eight thousand koku of rice. From this period also dates the custom of sending a congratulatory mission to Yedo on the accession of a new Shôgun to the Shôgunate. On these occasions, presents of silk, lacquer-ware, and Loochooan saké were made, and return presents were received by the members of the mission. In 1727, the tribute was increased to about 12,000 koku, which amount was collected annually by the Satsuma Han, until the year 1871, when the Han were abolished, and Ken established in their stead. Loochoo was then made a Han, and placed under the control of the Kagoshima Ken. The tribute continued to be levied on the same scale, with this difference, that instead of forming part of the revenue of the former—Satsuma Han—it was paid into the Ken exchequer, from which it found its way to the Finance Department at Tôkiô. In the following year, 1872, a mission arrived in Yedo to congratulate the Emperor on his assuming the direct control of the Government. Presents were exchanged between the two countries, and congratulatory epistles were presented to the Emperor and Empress of Japan by the King of Loochoo. In reply the latter received an Imperial message. This opened by stating that the climate and language of Loochoo were similar to those of Japan, and that as the King Shôtai held a high position, a fitting title was assigned to him, namely, that of King of the Loochoo Han, with rank amongst the nobility of Japan, and that in return he was expected to acquit himself well of his grave responsibilities, and render loyal assistance to the Crown. In the same year a further decree was issued, to the effect that the treaties concluded between Loochoo and the three foreign Powers of America, France, and I were to be considered henceforth as treati with the Imperial Government, and t Loochoo was to be under the control of the l Office, four Foreign Office officials wo stationed as residents in that country. A l was also assigned to them in Ida-machi, King was made an official of the first rank Loochooan Embassy then returned wit Japanese Foreign Office officials to thei country.

In 1873, Yonabara Oyakata, one of the Sa wan, accompanied by a suite of five subo officials and twenty attendants, was sent dent Commissioner, and established himsel Loochooan Yashiki in Tôkiô.

During the first three years of his resid the capital, it was customary for him to the Emperor twice every year at the festiv the Tenchô Setsu, and at the New Ye twenty pieces of silk cloth and thirty cotton cloth were presented. But, in l custom was abolished by the Japanese ment.

In the autumn of 1874, the Loochoan placed under the Home-office, and at secretary of the Home-office resides in Na conducts negotiations between the two ments. The amount of tribute was also by 400 koku.

China.—If certain ancient records may as correct, the Chinese appear to have ma attempts in centuries past to open up in with Loochoo. As far back as the ye Chinese official sailed from the port of Fo search of adventures, and was the fir countrymen to set foot in Loochoo. Bei to converse with the natives of the islan almost immediately, abandoning one of l crew, who was taken prisoner. The ne reception would seem to have reached th the Chinese Government, for, two ye another official visited Loochoo and d that the Loochooans should tender their su to China. This, however, they refused to accordingly, in the course of the next tw third Chinese mission arrived, bringing w it is stated, interpreters from Koron.* T choosans still proving obdurate, hostilit commenced by the Chinese, who burnt a carried off a number of prisoners.

The next we hear of relations betwee countries is more than 600 years after, when some Chinese who landed at Naf driven away by the natives with the loss men. For this outrage reprisals were made in the same year, and in the raid w Chinese undertook more than a hundr chooans were seized and brought back as to China. It was not till nearly a cent that the payment of tribute by Loochoo commenced. In 1314, a civil war brok Loochoo, which had the effect of dividi country into three separate States, each own king; and some sixty years after 1372, the Ming dynasty being in possessio Chinese throne, a Chinese mission ar Loochoo, and yielding to the pressure p

* In Chinese, Kivenham, meaning "fabulous region."

; of the Loochooan State—Chiuzan—
nger brother with a letter to the
ng. In this, he tendered his sub-
e Chinese Emperor, and accepted his
ıler of a vassal State. The kings of
› States shortly afterwards followed
thus given to them, and all three
d in their titles as kings of the three
uzan, Chiuzan, and Nanzan.*
1428, Loochoo became united once
:he rule of the king of the central
the following year the number of
rom Loochoo to China was fixed by
Government at two every alternate
was settled that the complement of
ıot exceed 150 persons. A Loochooan
ıce was also established at Foochow,
ınshikwan (or residence of the Han

e number of the Loochooan mission,
crews of the two vessels, was in-
' persons; and five more were added
n officials who had permission to
e tribute to Peking. Later on—the
uncertain—the Chinese enacted the
ibute every year; but, in 1857, in
f a memorial on the subject from the
hoo, the Chinese Government issued
.e following effect:—That the tribute
l once every two years; that the num-
sion, all told, should not exceed 150
that of these only the Ambassador
bassador, with a following of 15 per-
e allowed to visit Peking.
ə Loochooan Government petitioned
› be allowed to send another vessel,
kôsen," in company with the tribute
bject being evidently to secure in-
ies for trade. It is clear that the
ıt this time took advantage of the
tablished with China by means of
ships to carry on trade, for we read
ıey memorialised the Chinese Govern-
sking to be allowed to increase the
› mission, and to conduct their trade
These requests were granted. The
mission was increased to 200 persons,
ms duties on imports and exports
l. From this date till the year 1874,
change was made in the tribute to
ıt that of late years it became
r the two tribute junks and the
as we may call the additional ship
distinction) to go in alternate years,†
number of officials who visited Peking
:o six, with a suite of six attendants.
year, however, the Japanese Govern-
ın edict forbidding the payment of
ure to China.
bute.—Special missions were always
whenever a new Chinese Emperor,
ochooan King, ascended the throne.
sions the visit to Pekin was conducted
display, twice the usual number of
allowed to accompany the tribute to
Court.

* an-zan.
† ng the tribute junks to leave in the summer of
ekkôsen" would not leave till the following

On ordinary occasions the number of the mission was 20, but the attendants were numerous, and these, together with the crews of the two tribute ships, brought the total up to two hundred persons. The sekkôsen carried eighty people.

Fourteen officials, including the Saifu and Head Interpreter, remained in Foochow (one official, the Resident Assistant Interpreter, being appointed to reside in that town for a term of two years, being replaced at the expiration of that period). The Ambassador (Taifu), Peking Interpreter, Peking Chief Secretary (Yoriki and Gisha), in all six, with six attendants, proceeded with the tribute to Peking.

The tribute paid on ordinary occasions consisted of—Sulphur, 12,600 catties; copper, 3,000 catties; tin, 1,000 catties.

The tribute paid on the accession of a king in Loochoo was as follows: — For the Chinese Emperor—2 golden tevru (ornaments), 1 suit of armour, 2 pair of gold-mounted swords, 2 pair of silver-mounted swords, 20 swords, 10 spears, 10 halberds (naginata), 1 suit of horse trappings, 2 gold-mounted screens, 100 gold-mounted fans, 200 silver-mounted fans, 200 ordinary fans, 200 packages of raw cotton, 300 pieces of silk, 100 pieces of cotton, 500 catties of copper, 500 catties of tin.

The tribute paid on the accession to the throne of a Chinese Emperor was as follows:—For the Emperor—1 pair of golden vases, 1 pair of silver vases, 4 swords (gold-mounted), 4 swords (silver-mounted), 200 pieces of silk, 2 pair of gold-worked screens, 200 fans, 5,000 pieces of paper for screens and walls, worked in fancy patterns, 500 catties of copper, 500 catties of tin. For the Empress—1 pair of gold boxes, 1 pair of silver boxes, 80 pieces of silk, 80 fans. For the ex-emperor or deceased emperor—100 riôs, in money. In return for this tribute, presents were given to the King of Loochoo, and to nearly every member of the mission, even down to the common attendants.

OTHER FOREIGN INTERCOURSE.

The intercourse between Loochoo and other Foreign Powers has been very limited. In 1816, the islands were visited by H.M. ships *Alceste* and *Lyra*, and permission was received to bury on shore one of the sailors who had died during the stay of the vessels. Captain Hall, in his account of the Loochoos, speaks very highly of the kindness of the inhabitants, and states that although it was difficult at first to disarm the suspicions which the unexpected visit engendered, he ultimately succeeded in establishing the most friendly relations with the officials and people.

In the years 1844, 1846, and 1847, some French missionaries and an English doctor, were left on the main island by ships, the captains of which endeavoured to induce the Loochooans to trade with them, but without success, and in the ensuing ten years, other desultory visits were made by foreign vessels, in the course of which, several French missionaries were landed and left to reside, in some cases, for six or seven years. But these missionaries appear to have failed in their efforts to make converts, for, with the exception of one who died, all eventually left Loochoo.

In 1854, Commodore Perry, with an American squadron, visited Loochoo, and concluded a

treaty on behalf of the United States with that country, and in the years 1856 and 1859, respectively, similar treaties were negotiated by France and Holland. It is stated that the negotiations in each case were watched by emissaries of the Satsuma Han, who attended all the interviews as spies, attired in Loochooan dress.

Religion.

Loochoo has no state religion, but Confucianism, Buddhism, and Shintoism exist side by side, like Confucianism, Buddhism, and Mohamedanism in China. Confucianism is of the oldest date, and is the religion, so to speak, of the Court and upper classes, while all three are equally professed by the lower portion of the population. Ancestor worship, and the respect due to seniors, which is its natural outcome, are, more than any established creed, the guiding principles of Loochooan life. The two Buddhist sects, which have old establishments in Loochoo, are the Zen and Hokké. At Shiuri there are two or three temples, and the same at Nafwa. But, neither Buddhism nor Shintoism are regarded with much respect, and it is clear that they have no hold on the minds of the people. Both temples and shrines are of the rudest construction, offerings of devotees are conspicuous by their absence, and traces of persistent neglect are only too apparent everywhere. Of late years, a third sect of Buddhists has established itself in Nafwa, but owing to the determined opposition of the Government, the priests of this sect have not made much progress.

Schools.

There are 30 schools in Loochoo; 18 of these are in Shiuri, viz., one national school, for princes of the blood of Shizoku, from 18 or 19 years upwards; three Hira Gakkî, or district schools, for sons of noble families and Shizoku, from 17 and 18 downwards; and 14 Mura Gakkö, for sons of Shizoku and Heimin alike, from six or seven years upwards.

The course of instruction in these schools includes the Chinese classics, and the Japanese syllabaries. The school in Kirunei Mura, however, is set apart for the teaching of Chinese, and is attended by those who wish to become Chinese interpreters besides the inhabitants of that town.

Correspondence by letter is conducted both in the Japanese and in the Chinese style; but the latter is mostly affected by the higher classes, who receive special instruction in the different branches of Chinese education.

Women receive no instruction in reading and writing.

Weights and Measures.

The weights and measures used in Loochoo are based on those of Japan. The same terms are used both in square, lineal, cloth, and grain measure, and in calculating amounts of sugar; and with the exception of occasional differences such as dividing the "ei" into "go," "shaku" and "Sai"—a method which still prevails in Satsuma—the systems are the same.

Currency.

There is no gold or silver in Loochoo, and the only currency consists of the copper cash coined in Japan during the period of Kwany 1624-44).

Previous to this period, all commercial tions were carried on according to the p method of bartering one article for anoth remedy the inconvenience resulting from t of proceeding, rice gradually became the s by which values were estimated, and the reli custom exists to this day. The hire of a fixed at so many "sho" of rice, according distance of the voyage. In 1694, the Loo petitioned the Satsuma Government to be to issue a currency of their own, but the was refused, and they were further prohibit exporting the Japanese copper coins to During the visits of Chinese Envoys Chi were used in defraying their expenses, Kwanyei currency was kept carefully c from their sight.

The language of Loochoo is closely allie of Japan, its affinity with the Satsum being very marked. It resembles Japan polysyllabic character of its words, in t honorific suffixes with verbs, in the abse sound L, in its affirmative interjection corresponds to the Hé, Hāi, Nĕ, Nā, &c., and in the fact that, though the termin different, the roots of most of the ver same. Add to this that numbers of wo two languages, like Tai,* Uma, Ushi, are and it will not be saying too much to the language of Loochoo and that of identically the same in origin.

The chief differences between Loochoo present Tôkiô dialect in Japanese are as Ki in the Yedo dialect is replaced by Ch Shi becomes Si, and O, in many words, Examples of these changes may be fou following words:—

Japanese.	Loocho
Kikimasenu (present tense negative form of verb "to hear").	Chichabrian.†
Gosho (castle).	Ushui.
Ozato (name of district).	Ufuzato.
Otoko (man).	Uyekega.
Shima (island).	Sima.
Heimin (collective name for lower classes).	Feimin.

The sound of F in Loochooan is pecu pronounced as if it was written Fw. another peculiarity in the language dis tinguishes it from any other known ton is the extraordinary pronunciation giver in certain words. The only thing to wl be compared is the sound of a double co Japanese, as expressed in the words "am The peculiar accent rendered here in the double consonants is given in the case To take one or two instances, in the wor éyānchin" (merchant), "Fiyébara" (nam trict, "Samurĕye" (Samurai), this pec nunciation appears. It is a long dra vowel, the tone of the voice of the p speaks rising higher as the sound is utte pronunciation cannot be rendered in wor system of trans-literation would convey i

* Bird, horse, and cow.

† The connection between the terminal used her Japanese terminal Habera is clear.

ırd to be understood. There are, of course, words in Loochooan, such as "sidégafu" funaye" (thank you), and "Sō" (father), gin of which is distinctly foreign.

GENERAL REMARKS.

well known that Loochoo has no standing There have been no soldiers since its sub- by Satsuma in the beginning of the seven- century. The coincidence of this date with suma invasion suggests the probability that the conditions enforced by the conquerors at the population should in future be entirely ed. This condition, if it was enforced, has ly been fulfilled to the letter—not a sword instrument of warfare of any kind is to be the country; and the small guns which uted the armament of the junks which used e the voyage to China were borrowed from suma clan.

roads in Loochoo are of a very poor ion. Certainly the streets of the towns of Nafwa, Tonau, and Kumei are fairly well sted, and the paved road leading from to the castle at Shiuri, in spite of the rity with which the stone paving is laid, ompare favourably with some of the better roads in Japan. But, as soon as the leaves the neighbourhood of the towns, hes the open country, the roads become acks, quite impassable for any wheeled nce, and the absence of bridges is marked. e of the roads is sufficient to account for that such a thing as a cart is unknown in itry. The transport of produce is con- ither by pack-horses, or by coolies of both he women carring the load on their heads, e men carry it slung on a pole as in China ıan.

are very few shops in Nafwa and the owns, and none in the villages. Those xist are of the poorest kind. The buying ing of wares is carried on in the open air, efly by women, each town having several places, in which numbers of primitive e to be seen. A Loochooan stall is a very onstruction. A large umbrella is fixed in the ground, and serves as a protection sun and rain. Underneath this sits the woman with her stock-in-trade arranged her in small trays or baskets. In some ıd especially in wet weather, an additional le is made by propping up pieces of oil- o as to form a screen all round the stall- The articles thus exhibited for sale are h as afford any strong temptation to a er, and consist chiefly of eatables of various ruit, meat, &c., and also toys and ornaments hair. The produce from the surrounding is brought in every morning by women to ns and sold in the markets. Lacquer ware rse kind and earthenware are made chiefly r, and very little is to be seen exposed for the shops of the manufacturers. There is e village in Loochoo where potteries exist, s is in the immediate neighbourhood of

ıooan graves are similar to those in China, mode of interment differs. After death y is placed in a large earthen jar, and de- posited in the family vault, where it is left for three years, until it has become thoroughly decom- posed. The jar is then taken out, and the bones being removed and washed, are put into another jar, and replaced in the tomb. As in China, it is customary to hire professional mourners, whose business it is to cry at funerals; but the burial service is conducted according to Buddhist rites.

The division of the people into the two classes of "Shizoku" and "Heimin" has been attended with the worst consequences; it has had the effect of enervating the one class and degrading the other. The Samurai of Japan formed a vast stand- ing army; they were the product of a military system, which had for one of its objects the inde- pendence of the country; and though the privileges of their class were only maintained at the expense of the rest of the nation, there is no doubt that the military spirit thus fostered elevated the national character, and gave it a tone of inde- pendence which it otherwise would have lacked, and which can be traced in the Japanese farmer of the present day. In Loochoo the same class distinction exists, with all its faults and none of its advantages. The Shizoku of Loochoo has no spirit, no pride of country, and his pride even of self does not rise beyond the empty pharisaical boast that he is not a Heimin. The Heimin is an ignorant serf, who knowing that he is working for others and not for himself, has no heart in his labour, and lives from hand to mouth; and whose highest sentiment is a feeling of stupid respect for the privileged classes. The Loochooan Samurai is thus infinitely below his counterpart in Japan, while the peasant of Loochoo is even more immeasurably inferior to the Japanese farmer. Both classes live and think in the same grooves as centuries ago.

The hair-pin is the chief distinction between the two classes, that of the Shizoku being of silver, while that worn by the Heimin is made of brass. But there are other distinctions. Thus the Heimin is not allowed to wear clogs, he must not carry an umbrella as a protection from the sun, though he may use it in wet weather, and in the making of his clothes he is debarred from using cloth of certain patterns. Marriages between the two classes are very rare. There is one point, however, in which the Heimin of Loochoo had the advan- tage over the Japanese farmer under the feudal system. He is allowed to ride; and it is acknow- ledged that that the farmers are better riders than the Shizoku. At the races, which are held at stated times during the year, no prizes are given, but the losers dismount, and forming into line, salute the winner as he rides past.

I cannot leave this subject without pointing out what appears to me to be a curious fact in con- nection with the social division existing in Loochoo. This is, that while the men belonging to the Heimin classes are almost dwarfish in their stature, physical development, and the shape of their limbs, the Shizoku are, as a rule, fine big men, and are undeniably well made. Moreover, while the former in physiognomy resemble the Chinese, the latter have all the features of the higher classes in Japan. It may be that the degraded condition of the Heimin during many hundreds of years is sufficient to account for this distinction of feature and physical development,

but the existence of this clearly-marked difference leads one to suppose that a fusion of races has taken place at some remote period. I have been informed by a friend that he had occasion to observe the same thing amongst the Coreans.

That the hair-pin is one of the distinctions between the Shizoku and Heimin has been already stated. It serves to mark other differences of value. Thus, a Loochooan of the rank of Oyakata wears a hair-pin the head of which is gold but the rest silver. Again, that worn by the Sandzukwan and highest nobility is made entirely of gold.

The following explanation of the origin of the Loochooan hairdress is taken from a Japanese work on Loochoo:—

"In Japan, as it was in the reign of Saiko Kunô (A.D. 593—629), and before that date, it was customary for Japanese to wear hair-pins, which were worn in the queue, in a fashion similar to that now obtaining in Loochoo. The intercourse existing in that reign between Japan and Loochoo led to ranks and incomes being given by the Government of Japan to Loochooan nobles, and, as it was then customary in Japan to distinguish rank by the hair-pin, which was of gold or of silver, according to the status of the wearer, the practice was by degrees translated to Loochoo, and has continued up to the present time."

Relations between the Sexes.—The seclusion in which Loochooan women of the upper classes are kept is evidently a custom borrowed from China. It is considered a disgrace for a woman to be seen in public, and those who can afford the luxury never allow their wives to stir out of the house except in a covered palanquin. So strict are the rules affecting the intercourse between the two sexes that a Loochooan woman of the Shizoku class who meets an acquaintance of the other sex in the streets is not allowed to speak to him; both pass each other as if they were strangers. Nor is it considered proper for a man's wife to be seen by any visitor, except it be an intimate friend. To such a pitch is this feeling carried that persons have been known to live for years in the residence of a Loochooan without once meeting the mistress of the house.

In the construction of their towns the Loochooans resemble the Chinese and Coreans. It is true that the internal arrangement of a Loochooan house, in everything except the absence of cleanliness, is very similar to that of a Japanese dwelling. But here the similarity ends. In the roughly formed red and black or red and white tiles, of which the roofs are made, in the high walls, raised so that only the gables of the buildings are visible from the streets, in the arrangement of the courtyard, which suggests the idea of a fortification, and in the loftiness of the rooms, we see another influence at work. To any one coming from Japan, the first sight of a Loochooan town is rather pleasing, probably because it is so very different to anything in Japan; but, after a time, the long lines of walls on each side become excessively wearisome to the eye, and one misses the tasteful arrangement of garden and fence, which are such a pleasing feature in Japanese towns. The Loochooans, however, cling to their walls as to all their other peculiarities. They serve, so they say, "As a protection against fire, wind, and thieves, as boundaries between streets and compounds, and are useful in the interests of privacy." The last adv probably, that which carries most weight

Shiuri.

Those who in Shiuri expect to see remarkable, either in architecture o other respect, such as is generally to be in the capital of a country, will be dis Distant only two and a-half miles from t Nafwa, its white towers are clearly vis the anchorage. The town is grouped pict on the slopes of a hill, on the west stands the palace, or castle, commandi view of the sea to the south and v grounds of the palace are enclosed wit wall, and there are two gates by which be had to the interior. The principal through a gate, which opens on to the from Nafwa. After passing through always ascending, the visitor finds hi large courtyard, some 60 yards by 30, red tiles, placed closely together, and not to cover the whole space enclosed, a series of walks. Facing the entra audience hall, or Shô-in. This buildin in shape the large gateways built at t of Japanese temples; the front walls red and blue, and the roof is tiled in t manner. Anything more ugly can conceived. To the left are the offi Council of State, the principal hall of w as a guest-chamber. The ceiling an this room are ornamented with roug representations of tigers, cranes, and de right of the entrance is a low building, a suite of rooms occupied by members household, and through these a passa the king's apartments, which are at the audience-hall. The grounds of the ca turesque, and show evidences of forme care in construction, but little attenti now to be bestowed in this direction. T has much to recommend it. From the the castle we looked out on a successio green hills, sloping down to the sea, rich with barley and sugar-cane, and v with rice; and when we turned from th prospect and observed the marks of d where—the untrimmed walks and shr tropical luxuriance choked with weed not help thinking that where nature much, man might do a little more.

The streets of Shiuri, like the road are paved with stone, and, as the town a hill, and the Loochooan idea of roa that a road should lead straight up to hill and straight down again on the great precaution is needed so as to w falling. The Loochooans claim a great castle at Shiuri, and state that the buil stand now are, except for the fact tha been repaired whenever necessary, ide same that were originally erected. It probable that the castle stands much 600 years ago. The population of Shi 40,000, of whom three-fourths are Shizo these figures on the authority of my informants, but they appear rather 30,000 would probably be nearer the m

Paper on which anything has bee

at respect, and small stone erections in of boxes are to be seen by the road side. provided with cavities in which any old paper, on which characters have been placed and burnt. It is considered proper to throw such pieces of paper spite of this custom, which would seem a great respect for literature on the part chooans, it is a singular fact that there shops anywhere in Loochoo. The only k is the calendar which it is customary hooan Government to issue provisionally until the Chinese calendar is obtained g.

shipbuilding the Loochooans have the Chinese model, and it is the excep- the vessel rigged in Japanese fashion. junks which used to cross over to nd the sugar junks which, until the last o when they have been superseded by arried the sugar to the markets in and Osaka, are large vessels some 80 length, with a beam measurement of d a similar depth of hold. In every y are like Chinese junks even to the l in a conspicuous place.

DISCUSSION.

nan said there was so much matter in the was very difficult to discuss it thoroughly; be very valuable, when printed, for future

opher Cooke said it was the opinion of the len that, if he went down to the Universites Cambridge, and asked any of the students go was, not one in a hundred would be able n. He thought the same observation would choo; but he remembered reading of it as tain Hall's voyages, and had lately looked and made a few notes, which might be The Captain had fixed the latitude and ctly, said the religion was similar to that e, and that there was an observatory there. as only permitted to the king, and the hardly used. Capt. Maxwell, of the *Alceste*, nger, which was dressed by the native paste made of eggs and flour, and it was l in a hen's skin. Captain Maxwell made a thermometer, and Captain Hall of a al, which were carefully preserved. He at there were no deformed or diseased le, except a few who were marked with c. He referred expecially to the honesty of or when a watch, which had excited great ; mislaid, and it was feared it was lost, it back next morning, and the bringer refused eward. Captain Hall left them a sextant, d them how to use it.

man remarked that there were few more ooks than Captain Hall's travels. In con- Loochoo, he remembered his narrating omeward voyage he touched at St. Helena, eon was then residing, and found that the was much interested in hearing of these when he was told that in Loochoo there soldiers nor arms, it was quite beyond his n.

aid they were much indebted to the author but there was perhaps one oversight in it, there were no means of judging of the ticles in English money. It was very interesting to hear of a nation where there was no army, for he believed the worst expenditure of any country was that on armaments, though it might be necessary.

Mr. Hyde Clarke said it would no doubt be desirable to reduce the few prices and quantities given in the paper into their English equivalents. The sugar crop was very considerable according to the figures given, but the price was very low. He did not know why everybody should be supposed to know the exact locality of every place on the globe; but the book to which Mr. Cooke had referred was at one time very familiar, and no doubt thousands of copies were in existence. Since it was published, however, many other places had grown up into more importance, and the instance given of Chicago was very much to the point. It had rapidly sprung up into an immense city, whilst Loochoo had remained practically stationary. The relations of the Loochoo language were, of course, the same as those of the Japanese, as they are allied languages or dialects. Mr. Aston, a distinguished scholar of the Japanese Consular Service, had given in the last volume of the "Transactions" of the Royal Asiatic Society, a most valuable paper on the relations of the Japanese to the Korean. The Korean, and others in Western Asia, and also in America, were allied; but for reasons into which he need not go, it was requisite to go further afield, in what are called Turanian languages, to ascertain the real position of the Japanese, and, consequently, of the Loochoo. With this he had dealt at some length, as quoted by Sir E. J. Reed, M.P., in his paper, and particularly in his appendix to the second volume. The result at which he had arrived, was that the Japanese belonged to that earliest epoch of cultivation, in which were placed the Akkad-Babylonian, the Khita (with some Hittite), the Egyptian, Etruscan, Chinese, &c. All such as these have words which are identical, but these resemblances are distributed in various proportions. The cause was that the words were not derived from one primeval language of identical roots, as generally conceived, but from a variety of words for the same idea. The identity was not to be traced so clearly by similarity of sound, as by identity of psychological relations. Thus if we examined the Japanese or Loochoo numerals, 3 will correspond with Ear, 4 with Good, 8 with Arrow, 10 with Far. These were widely distributed laws of prehistoric language, dependent on various circumstances. In a system of numerations in which the eye figured as 2, the ear was 3. The Japanese have not preserved the relations of 2, but they have of 3. The arrow in the ancient Fetish mythology had a numeral relative, as all weapons and other objects have. Although we cannot, at present, trace Japanese and Loochoo migrations in detail, we know this, with certainty, that the origin of the language and mythology was most ancient, and constituted in forms corresponding with those of the founders of civilisation in the old world. At the present moment the difficulties of tracing each movement or phenomenon were very great, because many ancient forms are unknown; but with the advance of knowledge, we should, no doubt, obtain fuller results. At all events, it might be determined that we were not to regard Japanese as derived from Korean or from Chinese.

Mr. Sayematsu said there was a great resemblance between the language of Japan and Loochoo; and he had been told by a gentleman from the southern part of Japan that he had been in Loochoo, and that there were very many words which were identical. The most remarkable coincidences were the numerals. He did not say that the Loohcooan came from Japan, because the Japanese must have come from Loochoo. The date of the conquest of Loochoo by the Japanese was the 11th century, and even before that there were

records relating to the island. The fact that the king of Loochoo paid homage to China as well as to Japan could not be taken to be of much value, because in China all diplomatic messengers were said to be bringers of tribute; and probably on the same ground even England might be claimed as a tributary of the celestial empire. Japan actually conquered the island a little over 300 years ago; before that the King of Loochoo used to send tribute to Japan, but at that time, owing to internal disturbances, he neglected to do so. When tranquility was restored in Japan, and war was made on the Korea and China, the King of Loochoo was ordered to pay a share of the expenses, and as he did not do this, the Japanese Government sent and conquered the island. Since that time no doubt a certain tribute had been sent to China, but it was never recognised by Japan. Considering the position of Loochoo, it was very important to Japan that it shou'd not be under foreign influence, and therefore when it was apparent that the king was still keeping up relations with China, the Japanese Government could not pass it by, and that was the origin of the so-called annexation.

Mr. Pfoundes said these islands were, in the first instance, made known to Europeans by the early voyages of Albuquerque. The Portugese entered the Chinese sea about 1511, and, about 1516, they got as far as Canton. Albuquerque, the first Governor-General of the Philippine Islands, sent out an expedition in 1517, which, in the Formosa Channel, fell in with the Loochoo junks, which, it was supposed, were making their annual voyage to Loochoo. It was then a question with the Portuguese whether they might not push forward as far as Japan, which had been so much spoken of by Marco Polo, but their outrages on the coast where they landed, caused the repeated destruction of their settlements in the first year of the 16th century, and they were finally driven down towards Macao; their ill-repute gradually spread through the islands up to Japan, and intercourse with them was more or less cut off. The information with regard to Loochoo had been very admirably condensed in the paper, and there were very many points he should have liked to touch upon had time permitted. Every one would agree that it was a specimen of the first-class work done by the gentlemen of the Consular service, and he must, himself, tender his thanks to the Chairman for allowing him to make researches which were of the greatest interest. These islands, though they appeared very small on a Mercator chart, were in reality of considerable importance, and would prove still more so in future. Dr. Beltelhemier, when he landed, found some nuisances there, but though no doubt his conduct was very heroic in remaining for a long time in the face of annoyances purposely inflicted in order to make him leave the island, he feared he had not that tact which was requisite for making successful efforts in the country. This was one reason why so little had been done by medical or purely religious missionaries. The eminent Chinese scholar, Mr. Alexander Wylie, told him that he knew of the existence of a Hebrew manuscript, written by Dr. Beltelhemier, addressed to the Hebrews in China, but as the fact was there were no Jews in China, he believed it still remained undelivered in the hands of some of the missionary authorities.

The Chairman said the paper was a very suggestive one, but no doubt it would be improved by the addition of the English equations for the measures and prices. He had tried to roughly do this, and he found that the area of Loochoo was rather less than 1,000 square miles, and the population 166,000, which was very large for so small an area, considering that a great part was barren rock. The annual production might be estimated roughly at £100,000, which was probably a low estimate; it struck him as being exceedingly low—scarcely more than 12s. per head. He had no doubt, however, that the production was very low, as the condition
of the people was really one of considerable p
Their import and export trade amounted, in
numbers, to something like £77,000, which wa
small for such a population. The value of the
was not such as would have any appreciable ef
our consumption, being about £20,000. He th
the quantity was probably rather less than 1,000
It was a dark, black kind of sugar, only used b
Japanese, and they used much more Chinese
which was of a better quality. There could
be two more opposite instances than Chicag
Loochoo—of progress on the one hand, and stag
and political inanition on the other. No
Loochoo had a very ancient history, for the d
about it between the Japanese and Chinese we
as far as the 6th century. Japan collected
in A.D. 616, and China attacked and conquer
A.D. 620. Although so small a territory, it w
divided into three rival States, and he had see
the old castles which formed the stronghold
those three States, and was much struck
enormous strength. It was built of immens
put together without mortar. The state of th
showed the result of non-communication with t
There were very few nations now existing w
excluded themselves from the rest of the w
they were always found to have become stag
gone down hill—become fossils as it were.
was in that condition, but he hoped that a n
would now begin, and that fresh vigour
shown. Living alone, having nothing to
make laws for themselves, they went into m
details, and made the most elaborate form of
ment, embracing so many departments that
had judiciously omitted reading many of the
was a Herald's office, Woods and Forests, a L
berlain, and every description of office, and, i
seemed the only way they had of employing
It was a curious fact that this small popu
divided into two classes, nearly in the pro
half and half, so that nearly one half, viz.,
class, were entirely unproductive. This mu
how it was the population could be kept in o
out any particular military display. The
arms, though at first sight it might seem to
happy state of things, had not been able to
choo from annexation, and he feared that
millenium arrived, armies would be necessary
which desired to retain their independence. Th
between Loochoo and China and Japan wer
teresting, and with regard to the language,
room for much further study, because there w
of an earlier language and an earlier chara
had found stones there bearing inscriptions w
neither Japanese nor Chinese, and which the i
said was the ancient Loochoo language. He
gentlemen in the Consular service would cont
efforts to investigate these matters, and
succeed in tracing, not only the present dialec
pre-existing ones. In this case they had a n
extant, coeval with pre-historic times, and it
very interesting to trace the origin of the lang
see whether it came from the north or the
was certain that at one time a tide of populat
from the south to the north, for a strong
element ran through all the islands, right up
He concluded by moving a vote of thank
Gubbins for his paper, which was carried una

Dr. Mann said that he had reason to hop
service rendered to the Society by the Chai
evening, would be supplemented by a furth
bution regarding the commerce of Japan
future session.

The Chairman said it would give him great
to communicate any information he could g
practical a Society.

MISCELLANEOUS.

PRODUCTION AND PREPARATION OF SALT IN ITALY.

industry of the preparation of sea salt in Italy ording to a report recently issued by the United Consul at Milan, in a most flourishing condition, addition to supplying the wants of the Italian themselves, there is annually exported about tons, exclusive of the productions of Sardinia ily, where there exists no Government monopoly, om these islands about 100,000 tons are annually ted. The cost of production of common salt fifteen lire the ton, and it is estimated that overnment realises a profit from this article of ,000 lire annually. The places of production in are eleven, and almost all are Government ty; a part are let to private industry, while five naged directly by the State. The former are liari, Convecchio, Volterra, Salso-Maggiore, lice, and Trapani; the latter at Margherita, Corneto, Cervia, Lungro, and Portoferrago. r to hasten the evaporation and produce a good of natural salt, which is the main object of arti- lt production, a large expanse of level ground, the sea, and as near as possible to the sea level, ed. Enclosed by high dykes to prevent flooding gh seas or storms, the surface is subdivided into us levels, separated by little banks, as is practised ultivation of rice. The entire extent of the salt in communication with the sea by means of a hich serves for the ingress of the sea water and of the rain-water, and sometimes hydraulic is used to empty or fill the basin. Numerous canals and ditches run in several direc- rough the extent of the evaporating ground, is by these that the water is guided the different levels. In April the rays sun begin to gain force, and the equinoctial having passed, the damages of the past are repaired, and the rain water that may have l is pumped out, generally by hydraulic elevators, by centrifugal force. The rain water having cted, the canal to the sea lets in the salt water, hould cover the ground to the depth of about hes. The various levels of the salt farm should difference of about three inches, one above the e that the water may circulate slowly and freely e whole expanse. The water, exposed to the the sun, and under the influence of the wind, ites, and as it diminishes in volume it increases ity, and it is to facilitate this process that the m is constructed and the water passed from one another, until it has acquired the desired density, ich it is reunited in deep reservoirs. This process, imes repeated, lasts all through the month of it is in the month of June that the real work ipulating the water for the production of salt The water collected in the reservoir, and 15° to 20° Baumé of density, is pumped out her large flat reservoirs until, by evaporation, ires 25° of density; it is then spread over the ducing portion of the farm in extensive irs, of from 5,000 to 10,000 square yards, depth of two inches. The evaporation by the d wind concentrates the water, and causes to be deposited; small points are seen form- the water, which enlarge into crystals and the bottom, where they increase by the of other crystals; this process is slow and ous, when not interfered with by extraneous The salt reservoirs keep this large flat expanse continually filled with water to the depth of about two inches; the earth at the bottom begins to whiten, and a crust of deposits is found at the bottom of the water, which augments day by day, until by the month of August it becomes from two to three inches thick. The crop is then gathered, as a rain storm would destroy a portion of it; the superficial water is drawn off, leaving a deposit of salt, which is of a pure white, and shines like crystallised snow. The workmen then enter the salt farms, and with hoes, picks, and shovels separate the crust of salt from the earth, and carry it to the magazines in sacks, barrels, and carts. This work lasts more than a month, sometimes continuing until September, and it is necessary to employ a very large number of men, as a change of weather would have injurious results in the harvest of salt. During the whole of September and a great part of October, the soil of the reservoirs is washed out, and the water deposited in deep reservoirs, where it remains until the next year; the crystals that have been formed are, however, filled with impurities, and have to be subjected to the action of rain water during the winter, before they become saleable. As regards artificial evaporation, the principle that regulates the production of salt by artificial means is practically the same, but the manner of producing it is different, as the expensive process of reduction by fire is adopted. In various parts of Italy, at different depths, are found layers of salt, evidently deposited at remote periods, in strata, or mixed with heterogeneous materials. In all the wells in these localities the water is strongly impregnated with salt. The only two places in Italy where salt is worked by artificial means are Volterra and Salso-Maggiore, the former having wells 40 yards deep, often connected by underground galleries, and the latter an artesian well, of the depth of 300 yards. The water, on being pumped out, is deposited in large reservoirs, and afterwards in very large open boilers, under which fires are continually kept burning. The advantage of this system is its practicability at all seasons, and its independence of the weather, but the production of salt is much more expensive. The salt deposited and scraped up from the bottom of the boilers is of the whitest quality, but less granulated than the sea-salt, and is sold throughout Tuscany and in other places at the price of that passed through the mill. The salt wells of Volterra produce annually more than 10,000 tons, and those of Salso-Maggiore about 1,000 tons only. The salt of Volterra, on account of its purity, is mostly used for table purposes.

At Lungro, in Calabria, there is a salt mine which employs 400 hands; here the deposits are found in strata slightly mixed with extraneous matter of various formations, horizontal, perpendicular, and often in caves or pockets. This mine dates from ancient times, and has been often abandoned, but is at the present time in a flourishing condition. It is situated at the bottom of a valley, about 300 yards above the level of the sea, and is entered by a small aperture of about three square yards in the side of the Apennines. This tunnel, after a short distance, communicates with a subterranean gallery, descending by easy gradations and steps to the depth of 200 yards; connecting galleries and drifts lead in every direction, and the salt is extracted by blasting, and then broken up into fragments of convenient size for porterage. This mine produces about 7,000 tons annually, which is principally consumed in Calabria and the Basilicata; it is compact, pure, and white, like chalk, and translucent. The largest salt works in Italy are those of Cagliari, producing annually more than 130,000 tons of salt. On the coast between Marsala and Trapani, in Sicily, there are many private salt farms, and as no Government monopoly exists, any one is at liberty to cultivate this industry on his own lands. The salt farms of Trapani supply Rome, Naples, and Venice, besides exporting

realised by the Italian Government.

KAURI GUM OF NEW ZEALAND.

Consul Griffin, of Auckland, has written a full report on the production of kauri gum, which is largely used for the manufacture of varnish, of which the following is an abstract:—

It consists of the dried and solidified sap of the kauri tree, a species of pine known to botanists as the *Dammara australis*. It is found only in the province of Auckland, in that part of the colony lying to the northward of the thirty-ninth degree of south latitude, and does not exist in any other part of the world. The largest quantity of marketable kauri gum is dug out of the ground. It is found at various depths, from just above the surface of the soil to many feet below the surface. It is found on bare hillsides, on flat clay lands, in swamps, and even in some places that are covered with a more or less thick coating of volcanic *débris*. Sometimes the gum is found in small detached lumps, and at other times large deposits will be found in one hole. On cultivated land it is not unfrequently turned up by the plough, and in many places the cutting of large drains in swamps has revealed large deposits of this vegetable product. In the forks of the large branches deposits varying from a few pounds to nearly a hundredweight are sometimes met with. When a kauri tree is cut in the bark, even one of the largest and oldest, varying in diameter from six to ten or twelve feet, it will bleed like a young sapling. In a few weeks, if the weather be dry, a large mass of half-dried gum will have oozed from the wound, not unfrequently appearing in the form of a great thick band, reaching from the wound to the surface of the soil around the tree. When a tree is felled, the stump bleeds in a like manner until large masses of gum can be broken off from the stump. This "young" gum is white in colour, and has not the rich amber colour which age imparts to it when stored beneath the surface of the soil away from the action of sun and weather.

The gum is not soluble in water, It ignites freely, and burns with a lively sooty flame. It froths and bubbles, and produces a pleasant aromatic odour. The perfume it exhales when burning in the open air is not unlike that of frankincense and myrrh.

any special fondness for the work. They when they become pressed for food and account of the failure of their crops, or o Many Europeans have resorted to this ki but they belong generally to a class who and impatient of the restraints which a civi poses upon them, and who prefer to camp fashion of gipsies, and live in tents and ran than in houses fitted for civilised beings. I supposed that a European who resorts to is unfitted for any other occupation. He less, dare-devil sort of life, away from kindred, and from the restraints of civilisa

When the gum is taken out of the ground with earth, and its surface is found to b state of decay. When the digger is tired of his gum into a bag and carries it to his te in the evening or upon rainy days he, w ance of his wife and children, scrapes of surface until the clear solid gum beneat When a sufficient quantity of it has been put into a box or bag and taken to the n public house, where it is sold for what Sometimes the purchaser will assort it, generally sorted till it reaches the cit employs a large number of skilled hand pose. The gum, after it is scraped an packed carefully in boxes, so as to prev from breaking. It is then ready for exp and scrapings are also exported.

Some of the gum is used in New Ze manufacture of varnish, but in no great q export of kauri gum for the year 1880 i that of any other year. The total expor 3,410 tons, and 3,247 tons was the total e The invoices thus far received indicate shipment for the year 1880 will be 5,5 price of gum ranges, according to the *Scien* from 144 dols. to 720 dols. per ton. Th of it, however, is bought at the forme average price may be safely set down a ton. At this rate the total value of the e ment for the year 1880, viz., 5,500 t 1,188,000 dols. More than two-thirds o to the United States. It is either shippe and Boston in sailing vessels, or to Lon shipment to the American cities.

THE ENGLISH MILE.

;ye lately read a paper on the "English e the Academy of Sciences of Paris, and the inslation is taken from *Nature*:—

n that the mile of 1,609 metres long passed ish geographers and navigators as being of the terrestrial arc of 1′; in other made the degree equal to 60 of these eality it contains 69·5; there is thus an t one-sixth. This error, if it existed long neighbours, which I do not know, must many a shipwreck. It has had another ble result; it nipped in the bud the dis- e law of universal attraction. The first wton's great idea presented itself to his of failed him, because he made use of the glish mile to calculate the radius of the enounced the idea for a long time, and calculation up again when he learned the ard's measurement of a degree in France. es this defective estimate? Certainly it eed from any defective measurement, for gree measurements, among those which eally made, and not fictitious measure- hat of Posidonius, are far from presenting a magnitude. English geographers, then, nmitted some mistake in taking their mile documents.

navigation was limited to the waters of mean, and to coasting along the western rope, it was scarcely necessary to trouble ie of this element; but from the time that s of the Spaniards and Portuguese opened ister field, sailors were compelled to make r into the matter. I suppose that the gators applied to their geographers, and nd nothing better to consult than Ptolemy, e only authority in these matters. But self refers to Eratosthenes; he says that e measurements of the latter and found ult, viz., 500 stadia for the terrestrial ve thus been led to examine the measure- tosthenes. According to the documents ans have preserved, Eratosthenes measured of meridian which separates the parallels Alexandria, and finally found 700 stadia ee. This is how he worked:—He Alexandria, certainly by means of a zenith distance of the sea at midday ner equinox, and thus found 7° 12′. at at Syené the bottom of the wells was by the sun on that day, so that Eratos- led zero for the zenith distance of that ieve rather that the Greek astronomer servation to be made at Syené with a nstrument then very common in Egypt, distance resulted from an effective obser- l as in the case of Alexandria. We shall conjecture is perfectly justified. We e observations made on the dark shadow ear a constant error equal to the semi- e sun, or, to speak more accurately, that zenith distance of the upper edge of that ncients do not seem to have remarked act, as they deduced from their observa- obliquity of the ecliptic or the epoch of did not concern them, for, by combining ns of the summer with that of the winter ror in question disappeared from the dif- it is exactly the same here, since we have absolute latitude, but with the difference wo places at which the centre of the sun idday on the same side of the vertical. itude 7° 12′ concluded by Eratosthenes as moreover the advantage of not being d by refraction.

Here is a first verification. On opening the *Connaissance des Temps* we find—

		°	′
For the latitude of Alexandria	....	31	12
,, ,,	Syené	24	5
Difference	....	7	7

instead of 7° 12′. The difference, whatever may be the cause, is very small.

Here is a second and more delicate verification. The latitude of the point in Alexandria, where Eratosthenes observed, could not differ much from that which we have given. By adopting that and 7° 12′ for the zenith distance of the upper edge of the sun at the winter solstice we find 31° 12′ — (7° 12′ + 16′) = 23° 44′ for the obliquity of the ecliptic. Syené gives 24° 5′ — 16′ = 23° 49′. It is possible that in the year 250 B.C. the obliquity of the ecliptic was from 23° 44′ to 23° 49′? From 1750 A.D. to 250 B.C. is 2,000 years. At the rate of 48″ diminution per century the obliquity would be 23° 28′ 18″ + 48″ × 20 = 23° 44′. The observation of Eratosthenes at Alexandria is then authentic, and, moreover, very precise. That of Syené presents an error of only 5′.

There remains the geodetic operation. Egypt was the only country of antiquity which rejoiced in a survey. The valley of the Nile was very populous at that epoch, as far as Syené, and no doubt the survey extended thus far. Eratosthenes must have had every facility for procuring the necessary documents. He must have taken into account the difference of longitude of 2° 59′ which exists between the two cities, without having had to determine it directly. I regard, then, the distance of 5,000 stadia, in round numbers, as being quite as accurate as the other part of his operation, and as applying to the arc of meridian comprised between the parallels of the two cities.

We finally conclude from this 694·4 stadia for the degree. The Greek astronomer gave, in round numbers, 700 stadia. What was this stadium? To reply to this question I calculate the arc of meridian from Alexandria to the parallel of Syené, with the actual element of the terrestrial ellipsoid. It is 797,760 metres. At the rate of 5,000 stadia we find 159,55 metres for the stadium. At the rate of 600 feet for the stadium, the foot adopted by Eratosthenes would be 0·266 metres. This was then the ancient Egyptian foot, which we now reckon at 0·27 metre; and, in fact, it was with this foot that the survey of Egypt must have been made. By this reckoning the 5,000 stadia give 5,000 × 600 × 0·27 = 810,000 metres, showing a difference of 12,240 metres, partly owing to that of the points of departure, partly to the error which we perhaps make in the length of the Egyptian foot in carrying it to 0·27 metre. Thus the measurement made in Egypt, more than 2,100 years ago, by an able Greek astronomer, is as good as authentic. All the existing causes of uncertainty do not alter it more than one-sixth. It is certainly not from this quarter that the error can come for which we seek.

Nor is it in the measurement of Ptolemy, for he tells us he went through the same operations and found the same results; only he gives 500 stadia to the degree instead of 700. This difference is evidently due to the fact that Ptolemy, who lived 400 years after Eratosthenes, under another domination, did not make use of the same foot. In fact he employed the stadium of 600 Phileterian feet, and as this foot is about 0·36 metre, while the ancient Egyptian foot was only 0·27 metre, he had to reduce 700 stadia of his predecessor to $700 \times \frac{27}{36} =$ 525, or 500 in round numbers.

These estimates are confirmed, finally, by the Arabian astronomers, who measured, in 827 A.D., an arc of 1° in the plains of Mesopotamia. They found fifty-six miles, and concluded that they had thus verified the number of Ptolemy. The Arab mile being 2,100 metres, the arc

measured is found to be 117,600 metres, which corresponds to a stadium of 235 metres. This is very nearly the Phileterian stadium of 216 metres, except the error of the measurements seven times more sensible on so small an axis, and the uncertainty of our existing estimate of the Arabian mile in the time of the Kalif Almamoun.

To resume: the estimate of Ptolemy is only a sort of conversion of the excellent measurement of Eratosthenes in units of another epoch and of different length. It would thus lose a little of its first precision; but, such as we find it in Ptolemy, the English geographers were fully justified in taking it for the basis of a valuation of the arc of 1′ and of offering it to the navigators of their country. Only, and it is here the mistake lies, they believed that the great Greek astronomer of Alexandria must have made use of the Greek foot. This is one and a half hundredths larger than the English foot. If the English geographers of the sixteenth century had strained this valuation ever so little, and had carried it to $\frac{5}{100}$ths, they would have found 630 English feet for the stadium, which they believed to be 600 Greek feet, and these 630 feet or 210 yards, multiplied by 500, would give them 105,000 yards for the degree and exactly 1,760 yards for the mile. The English mile, then, has evidently been deduced from the measure of Ptolemy; its error of one-sixth is solely due to the fact that the Greek foot has been confounded with the Phileterian foot.

QUININE MANUFACTURE IN ITALY AND GERMANY.

The following account of the manufacture of sulphate of quinine in Italy, with suggestions as to the cultivation of the cinchona tree in the United States by Consul Crain, of Milan, is taken from the *Journal of Applied Science*. The manufacture of salts of quinine is an important Italian industry. It has been carried on at Milan and Genoa since 1870. Twenty-two thousand five hundred pounds are consumed yearly in Italy, of which one half is made at Milan, 6,750 lbs. at Genoa, and the balance imported from Germany. Forty-five thousand pounds of quinine and salts of quinine are produced in Italy. The production of the world is estimated at from 230,000 lbs. to 260,000 lbs. per year, as follows: — Germany, 56,250 lbs.; Italy, 45,000 lbs.; France, 40,000 lbs; England, 27,000 lbs.; America, 63,000 lbs.; India, 12,250 lbs. The two Italian factories produce 45,000 lbs. of the sulphate of quinine, viz., 40,500 lbs. at Milan, and 4,500 lbs. at Genoa. The first of these employs 45 hands, the second 15. The Milan factory ships largely to all parts, furnishing large supplies to Russia, France, and Austria. England receives two-thirds of her supply, and Holland one-half of hers from the same source. Efforts will be made to acclimatise the cinchona in Italy, to increase the supply and lessen the cost of the product. Its successful culture in India and Ceylon encourages the belief that it will grow wherever the soil is dry, the rainfall large, and climate temperate. Many parts of the United States fulfil these conditions, and notably where its product is needed. The culture of the cinchona in America would cheapen an indispensable medicine, and open a new industry to capital and labour. In this connection some facts reported by Mr. E. Van Eetvelde, the Consul-General of Belgium in India, are instructive. He reports that the best varieties of cinchona have been successfully acclimatised in British India. The Government there cultivate chiefly the *Cinchona succirubra*, which contains a large quantity of febrifuge alkaloids, and the *Cinchona calisaya*, which is better suited to the manufacture of quinine. The culture of the first has been successful. Uncertainty still exists as to the *Cinchona calisaya*, and the Bengal Government are examining the plantations of Java, where it has been cultivated with entire suc
cinchona plantations are in two distinct
India—in the north of the Neilgherry Hi
Madras Presidency, and on the slopes of
layas. Those of the Government are as y
important, covering 1,300 acres on the
Hills, and nearly 3,000 acres in Sikkim. There
private plantations of later date already
marketable bark. The red bark (*Cinchona*
has many febrifugal alkaloids, but little q
was important, therefore, to determine the
value of the alkaloids and the cheapest m
traction, in order to furnish a good febr
moderate price. The Medical Commission re
the extraction of cinchonine, cinchonidin
quinine by simple means, and the Govern
sells a mixture of these three alkaloids unde
of "Cinchona febrifuge." As the pric
exceed 2s. 7d. per oz., this febrifuge is used
all the hospitals of India, and sold in larg
to the public. The chief surgeon of the
province reports that the doctors are un
declaring that the "Cinchona febrifu
medicine of recognised efficiency in the
of ordinary intermittent fevers, and tha
excellent prophylactic for those who live
in marshy countries. Most doctors are
of the opinion that it is inferior to qu
therapeutic agent, that its effect is slower
it is insufficient to cure severe intermitt
That it is a medicine of value is shown by t
in its use in the Indian hospitals, which, as
ing figures show, is remarkable:—1874-
1875-76, 1,940 lbs.; 1876-77, 3,750 lbs.
5,162 lbs.; 1878-79, 7,007 lbs. The hospital
than 5,500 lbs. in 1878-79, and, as the use
diminished in the same time about as much, i
considering the cost of the last-named alkal
Indian Government saved about £25,000. At
time the Government chemist of India is try
duce a better febrifuge, by mixing three sul
cinchonine, cinchonidine, and quinine, of
cost would be a little higher. Financially,
tions of Sikkim gave last year a net profi
£4,000, although not fully developed, or 4½
the sum invested.

From an official report recently published
that within the German Empire there are
manufactories, of which Prussia, Wurtemb
Brunswick, and Hesse have one each. T
portant German establishments are those of
Frankfort-on-the-Main; of Böhringen, in
and of Jobst, in Stuttgart. The Zimmer es
was founded by Dr. Conrad Zimmer, in th
and soon acquired considerable renown.
very complete and extensive manufactory;
about 50 bales of cinchona bark, and produ
kilos. of quinine daily. The principal pre
the German establishments are the su
muriate of quinine. Of unbleached,
hospital quinine, made from various alk
produce very little; while the cinchonid
is manufactured in large quantities, especi
port to the States. The efficacy of this dr
be similar to that of quinine, while its price
third or one-fourth that of the sulphate
Amongst the numerous other salts and pre
quinine made in Germany are chiefly to be
the preparations of the amorphous quinine
the muriate. These preparations, bein
soluble, are much employed for injections
fever resulting from wounds, and are there
ticular importance to army hospitals. T
manufacturers get their cinchona bark
London or Paris, which are the principal
that commodity. The bark is also brought
to Amsterdam from Java by the Dutch Gov

years occasional lots have been imported at

immer factory at Frankfort, two or three years ught large territories in Java, and now employs ro hundred natives in clearing ground and plant-hona.

H ASSOCIATION MUSEUM AT YORK.

British Association for the Advancement of having decided to hold its annual meeting this York, where, fifty years ago, its first meeting 1, it has been thought that advantage should be this jubilee meeting to show, as far as possible, gress which has been made during the past half in the construction of instruments of scientific , and, with this view, it has been decided to nen of science, scientific societies, and manu-s, to exhibit, at the meeting, instruments of the atterns, and tools used in their construction; the science be fifty years old, the instruments 1831; otherwise specimens of the earliest that can be found.

proposed exhibition will also include apparatus ecimens illustrative of papers to be read at the tion meeting, which the authors may be willing to be examined at leisure, as well as instruments cted for the prosecution of special researches have not yet become articles of ordinary com- It is very desirable that such instruments and tus should be exhibited in action, if arrange-an be made for the purpose.

exhibition will be for the week of the meeting iz., from the 31st August to September 8th. To that specimens entrusted for exhibition shall be antageously placed as possible, a special sub-ttee, called "The Museum Sub-Committee," has rmed at York, who will afford every possible ation.

lications for space should be sent to the Hon. ries, British Association Offices, 17, Blake-street, as early as practicable, but in any case not later e 15th day of July, 1881.

RTIFICIAL SEASONING OF TIMBER.

C. René, pianoforte manufacturer, of Stettin, ny, as reported in *Engineering*, has devised a plan ich he utilises the property of oxygen, particu-of that ozonised by the electric current, to ially season the timber used for the sounding-of musical instruments. The first impulse to ments being carried out in this direction was by the well-known fact that wood, which has seasoned for years, is much more suitable for the facture of musical instruments than if used soon it is thoroughly dried only. Mr. René claims nstruments made of wood which has been treated oxygen process possess a remarkably fine tone, not only does not decrease with age, but as far as ience teaches, improves with age as does the tone of famous old violins by Italian masters. We are r told that the sounding-boards made of wood pre-in this manner have the quality of retaining the longer and more powerfully. A number of pianos factured at Mr. René's works, and exported to opics several years ago, have stood exceedingly and seem in no way affected by the climatic s they are exposed to. While other methods of rating woods with chemicals generally have a orating influence on the wood fibres, timber pre-by this method, which is really an artificial g, becomes harder and stronger. The process is, to be regularly carried on at Mr. René's works, and the apparatus consists of a hermetically closed boiler or tank, in which the wood to be treated by the process is placed on iron gratings; in a retort, placed by the side of the boiler and connected to it by a pipe with stop-valve, oxygen is developed and admitted into the boiler through the valve. Provision is made in the boiler to ozonise the oxygen by means of an electric current, and the boiler is then gently fired and kept hot for forty-eight or fifty hours, after which time the process of preservation of wood is complete.

ACTINIC BALANCE.

Professor S. P. Langley, of the Alleghany Observatory, U.S., has devised a new instrument, which is said to be considerably more sensitive and accurate than the best thermo-pile, and which he terms an actinic balance. The principle of the apparatus is explained as follows:—A differential galvanometer, that is, a galvanometer with two equal coils of wire wound oppositely round the needle, has each coil connected in circuit with a strip of thin steel, and the same electric current is split up between them. If the resistances of the two steel strips are equal, the current will be divided into two halves, one half traversing one coil and the other half the other coil. These two currents will neutralise each other's influence on the needle, which will remain undisturbed. If, however, the temperature of one strip is raised above that of the other by exposure to a source of heat, the hotter strip will increase proportionately in its electric resistance, and the balance of currents on the needle will in turn be proportionally disturbed. The deflection of the needle will in fact indicate the change of temperature in the exposed strip. The strips employed by Professor Langley are thin steel bands $\frac{1}{500}$ millimetre thick, $\frac{1}{2}$ in. long, and $\frac{1}{10}$ in. wide, and several of them are placed side by side to get a broader surface exposed to the heat rays. As at present constructed, the instrument is said to be from 5 to 100 times as sensitive as the most sensitive thermo-pile, and its sensibility can be increased by coating the strips with lamp-black.

CORRESPONDENCE.

BAMBOO IN CEYLON.

In the discussion that took place after the reading of Sir Arthur Phayre's paper on British Burma, on the 13th May, I see that a quotation I read, bearing on the growth of bamboo, from the *Gardener's Chronicle*, of the 30th of April, is (inadvertently) omitted, referring to the Royal Botanical Gardens at Peradenya, Ceylon. H. J. E., a keen observer, writes:—

"Perhaps the most striking objects in these gardens are the extraordinary clumps of giant bamboo, which exceed anything I have ever seen or heard of. In some of them not less, and probably many more, than 200 culms of over 100 feet high are growing, as tightly packed together as possible. Some of the stems must be very nearly, if not quite, a foot in diameter, and the average, eight or nine inches. This splendid bamboo is, I believe, a native of the Malay Peninsula, and is the most remarkable instance of rapid growth I know of, each of these immense stems being formed in a few months."

To lovers of botany, a fine specimen of this bamboo may be seen at the Duke of Northumberland's garden, at Sion-house, Chiswick. I have a stem here from that clump, nearly 70 feet high, the top of which pushed its head through the roof of the conservatory.

THOMAS ROUTLEDGE.

Claxheugh, Sunderland, 30th May, 1881.

NOTES ON BOOKS.

New Commercial Plants and Drugs, No. 4. By Thomas Christy. London: Christy and Co. 1881.

Among the commercial plants described by Mr. Christy are the Ceara, the Mangablera, and the Apocynaceous rubbers, Landolphias, from Western Africa, and Chinese and Japanese peppermint plants. Chaulmugra oil, as a substitute for cod liver oil, varieties of bark, caroba leaves, Chian turpentine, and some plants already noticed in this *Journal*, are included under the head of new drugs. The descriptions of eleven new drugs from Japan, used for rheumatism, congestion, and many other diseases, conclude this part. One of them—mahng dah-rah-gay (*Datura alba*) is used by the natives of India for poisoning, and professional poisoners are often called dhatureas, on account of the use made of this drug.

Water-works Statistics, 1881. Edited by Charles W. Hastings. First issue. London. 1881.

An alphabetical list of towns is here given, with particulars in columns of source of supply, price, dividends, and other information. One hundred and thirty-four towns have made a return; 108 give source of supply, 131 state whether the supply is obtained by gravitation or pumping, 69 quantity raised per annum, 127 rental or assessment, 86 meter charge, 90 price per 1,000 gallons, 99 number of meters in use, 130 if constant or intermittent service, and 46 amount of dividend.

Gas-works Statistics, 1881. Edited by Charles W. Hastings. Third issue. London. 1881.

Returns from 726 towns in the United Kingdom are here given, which contain information respecting the number of tons of coal carbonised, the make of gas, illuminating power, price per thousand cubic feet, price paid for public lamps, and amount of dividend. About half the returns also give the illuminating power of the gas, and 200 the price realised for coke.

The Gas and Water Companies' Directory, 1881. Edited by Charles W. Hastings. Fifth issue. London. 1880.

This volume contains the dates of formation, the capital, the names of the engineers and secretaries of the companies, besides other information, and the population of the places, as well as their distance from London.

GENERAL NOTES.

Glass Making.—The following statistics relative to the manufacture of glass in the United States for the year ending May 31, 1880, compared with the results obtained by the census of 1870, is obtained from a preliminary report of the Census-office:—

	1880.	1870.
Number of establishments	194	154
Employes	23,822	15,367
	Dols.	Dols.
Capital	19,415,599	13,826,142
Wages paid	9,112,301	7,589,110
Materials used	7,991,303	5,904,365
Value of product	21,603,464	18,470,507

The investigation into the growth and exten dustry included only those works which manu from the crude material, and not those in wh tured glass is a raw material, such as ma painted or stained glass, mirrors, chemists' wa

Colour of Seeds.—Mons. Pauchon h series of experiments with beans, on the inf colour of seeds on germination, with this result, in order to reach the same visible stage of d black or violet seed absorbs more oxygen tha yellow one, though a more rapid germination i the latter. On the other hand, the quantitie acid exhaled by white seeds are found to be greater than those from the dark, sometimes These differences are considered to prove that seeds are better conditioned from a physiolo view. In the natural state, *i.e.*, when the se in light—the conversion of legumin into aspa on much more easily in the coloured seeds tha "The more frequent and pronounced pigment of northern lands is, therefore," says M. favourable circumstance for the growth of th under the peculiar light-conditions to wl subject."

MEETINGS FOR THE ENSUING

MONDAY, JUNE 6TH. Royal Institution, Albem 5 p.m. General Monthly Meeting.

Geologists' Association, University Colleg sion to the Isle of Wight.

TUESDAY, JUNE 7TH...Royal Institution, Albem 3 p.m. Prof. Morley, "Thomas Carlyl

Biblical Archæology, 11, Hart-street, 1. Mr. Theo. G. Pinches, "Remarks on coveries of Mr. Rassam at Aboo-habba. "Notes on the Recently-discovered Py Sakkara. VI. Dynasty." 3. Prof. E. "Description of Mentuhotap." 4. Mr. "Was Piankhi a synonym for Sabako?

Zoological, 11, Hanover-square, W., 8½ p

WEDNESDAY, JUNE 8TH...Geological, Burlington-h 1. Prof. H. G. Seeley, "The Reptile Gosau Formation." 2. Prof. T. McK. Basement-beds of the Cambrian in An J. S. Gardner, "Description and Co Bournemouth Beds." Part II. "Lowe Series." 4. Mr. Robert F. Tomes, "I New Species of Coral from the Middle shire."

Microscopical, King's College, W.C., 8 p.

Royal Literary Fund, 10, John-street, 3 p.m.

THURSDAY, JUNE 9TH...Royal Institution, Albem 3 p.m. Prof. C. E. Turner, "Russi (Lecture III.) "Tourgenieff."

Inventors' Institute, 4, St. Martin's-place

Mathematical, 22, Albemarle-street, W., 8 Cayley, "The Gaussian Theory of Surf Genese, "System of Co-ordinates Discl sion of all Non-Metrical Properties of C Cubics and Bicircular Quartics with 3. Mr. J. J. Walker, "A Theorem in Operations." 4. Mr. J. W. L. Glai Symbolic Operators."

FRIDAY, JUNE 10TH...Royal United Service Institut yard, 3 p.m. Captain Walter James, "I tion."

Royal Institution, Albemarle-street, W., 8 Meeting. 9 p.m. Prof. Dewar, "Origi of Spectra."

Astronomical, Burlington-house, W., 8 p.m

Quekett Microscopical Club, University 8 p.m.

New Shakspere, University College, W.C. Poole, "The Alterations in the Actin Shakspere's Plays."

SATURDAY, JUNE 11TH...Physical, Science Schools, S ton, S.W., 3 p.m. 1. Prof. W. Chandler Hardening of Steel." 2. Mr. W. Gras Electromagnetic Induction."

Royal Botanic, Inner-circle, Regent's-park,

Royal Institution, Albemarle-street, W., C. E. Turner, "Russian Literature." "Nekrasoff."

OF THE SOCIETY OF ARTS.

No. 1,490. VOL. XXIX.

RIDAY, JUNE 10, 1881.

ns for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

RS. BUCKTON'S LECTURE.

ry to the Domestic Economy Congress, n, author of "Health in the House," at the Royal Albert Hall, a lecture her method of teaching Domestic ; Leeds, with copious diagrams and on Thursday, June 16th, at 11.30 a.m. ay be obtained on application to the the Congress, Society of Arts, John- hi.

FURNITURE EXHIBITION.

bition of Works of Art Applied to n connection with the Exhibition of ; the Royal Albert Hall, is now open on-transferable season ticket will be member of the Society on application ary.

EXAMINATION IN VOCAL OR INSTRUMENTAL MUSIC.

Examination in London will be held lah, the Society's Examiner, at the e Society of Arts, 18, John-street, C., during the week commencing on , 1881.

HONOURS.

ination in Honours will consist of s, viz., a paper to be worked, an similar in form to the practical for a First and Second-class, and a mination.

IRST AND SECOND-CLASS.

Vocal.

for a First or Second-class Certificate ic will be required—

g a solo, or to take part with another a duet, already studied.

-note being sounded and named by r, the candidate to name sounds or successions of sounds or intervals, g by the Examiner.

g or sol-fa at sight passages selected m classical music.

Instrumental.

for a First or Second-class Certificate tal Music will be required—

[1.] To play a short piece, or a portion of a larger work, already studied.

[2.] A key-note being sounded and named by the Examiner, the candidate to name sounds or intervals, played by the Examiner.

[3.] To play a piece or portion of a piece at sight.

The examination of each candidate will be private; no one but the Examiner and the accompanyist being present, unless it be a member of the Society of Arts' Committee.

No list of Candidates will be published.

Full particulars can be obtained on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

CONVERSAZIONE.

The Society's *Conversazione* was held at the South Kensington Museum (by permission of the Lords of the Committee of Council on Education), on Thursday, 2nd June.

The Galleries containing the Raphael Cartoons, the Sheepshanks Collection, the Wm. Smith Collection of Water Colour Drawings, the Dyce and Forster Pictures, the Collection of Paintings lent by the Trustees of the late Rev. Pryce Owen, and "The Chantrey Bequest," as well as the Courts and Corridors of the Ground Floors were open. The Reception was held in the Architectural Court, by Mr. F. J. BRAMWELL, F.R.S., Chairman, assisted by the following Vice-Presidents and Members of the Council:—Professor Abel, F.R.S., Mr. Brudenell Carter, Mr. B. Francis Cobb, Sir Philip Cunliffe Owen, K.C.M.G., Mr. W. H. Preece, F.R.S., Mr. Robert Rawlinson, C.B., and Mr. Owen Roberts.

A Promenade Concert was given by the String Band of the Royal Engineers (Conductor—Herr J. R. Sawerthal), in the North Court, the following being the programme of music performed:—

1. Overture	"Giralda"	Adam.
2. Selection	"Don Giovanni"	Mozart.
3. Musette	"Amors Küsse"	Morley.
4. Serenade	"Ständchen"	Schubert.
5. Fantasia	"Dinorah"	Meyerbeer.
6. Chor der Schaarwache		Gretry.
7. Selection	"Pirates of Penzance"	Sullivan.
8. Spanische Tänze (a) Moderato. (b) Bolero.		Moszkowski.
9. Waltz	"La Berceuse"	Waldteufel.
10. La Retraite Militaire		Lefévre.
11. Marche Romaine (Pius IX.)		Gounod.

Mr. Corney Grain gave an Entertainment in the Lecture Theatre, and Madame Frickenhaus' Pianoforte Recital was given in the Picture Gallery, the programme of the three parts of which was as follows:—

a. Etude, No. 3 b. Scherzo, Op. 20	Chopin.
a. Traumeswirren b. Einsame Blume c. Novelette, Op. 99	Schumann.
a. Capriccio (for the left hand)	Rheinberger.
b. Scherzo, from Sonata in A flat	Weber.
c. Tambourin	Raff.

The number of visitors attending the *Conversazione* was 2,710.

EFFORTS TO IMPROVE NATIVE HUSBANDRY IN SOUTH INDIA.

By Wm. Robertson.

In May, 1880, I had the honour to read before the Society of Arts a paper on "The State of Agriculture in South India." Since then the Indian Famine Commission report has been issued, and several important papers, embracing many of the subjects dealt with in my paper, have been read before this and other societies. Of course, on such questions some differences of opinion must exist, but, on the whole, the opinions expressed agree, generally, with those I ventured to place before you. My conclusions may be summarised regarding South India as follows:—

(*a.*) The good land is already under tillage; any addition made to the tillage area must therefore consist of inferior soils.

(*b.*) Additions made to the tillage area must be at the expense of the area that produces scrub-jungle and grass, which afford the ryot—free of cost—fuel for domestic use, and grazing for his stock, which resources thereby become lessened.

(*c.*) The addition of large areas of poor soils to the area under tillage, increases the necessity for applying manure, while the corresponding decrease in the area yielding fuel and grazing, diminishes the ryot's means of supplying this manure.

(*d.*) The proportion of the occupied area, cropped annually, is considerably greater now than at any previous period, thus the benefiting influences of "fallowing" are less exercised.

(*e.*) Half-tilled, unmanured, arable land, bare for six months in the year, is much less able to retain and store the rainfall than the land when under scrub-jungle; the rain-water flows more quickly off the land into the beds of streams, and the irrigation sources dry up sooner in the season.

(*f.*) There is, generally, a great waste of irrigation water; were the water used with care, the irrigable area might be largely increased.

(*g.*) Famines occur during long periods of drought, when the crops cannot obtain the water they require.

(*h.*) The half million persons added yearly to the population of the Presidency, rely for food chiefly on crops raised on inferior soils, farmed without the aid of irrigation water, and almost without manure.

(*i.*) Under present conditions, famines are likely to become more frequent and more severe.

(*j.*) Under good husbandry—by deeper tillage, and by the use of organic manures—the soils might be made much more fertile, and the crops rendered less liable to suffer injury during a moderate drought.

(*k.*) The welfare of the State depends upon the condition of agriculture, even to a greater extent now than formerly, seeing that it has guaranteed to protect the people against the effects of famine.

(*l.*) A primitive system of husbandry, which sufficed to meet the wants of a scanty population, when there was plenty of good land available, no longer suffices, now that the demand for human food has become so great, and such a large area of poor soil has to be tilled.

Early in the present century attention was given by the State to the improvement of indigenous varieties of cotton, but nothing on an e: was attempted until about 40 years a; Marquis of Tweeddale was Governor o Cotton Department was then organise farms were established in various Presidency. These so-called farm explain, were mere tracks of land, fr fenced, and generally without any bu land was devoted exclusively to tl cotton. On these farms, crops Egyptian, and New Orleans cotton from imported seed, and the seed distributed over the Presidency; but devoted chiefly to the culture of the b indigenous cotton, which, it was thou improved by better culture, the liber able manures, the careful selection of for sowing, &c. These farms were un charge of men who had been brought and who were supposed to possess knowledge of the cultivation of co treatment when undergoing prepar market. In connection with these farm were carried on in ginning and packing port. These cotton farms were carried time in the face of many difficulties. able experiments were carried ou important information was collecte Governor having been appointed, interest in agriculture, the parti opposition, which had existed fo assumed an active form, and the C ment was eventually suppressed. no doubt whatever that the adn the department was defective in sc respects. But, taking into accoun agricultural knowledge at that per difficulties to be overcome, and tl the class from whom aid and s have been hoped for, the experim as successful as in reason could It was certainly a mistake to confi tions of the farms exclusively to c Had efforts been made on a simi with the same persistency, to impro generally, any improvement secure acted for good on cotton culture, a thus obtained would have been m their influence. It was also a deci import largely seed of superior vari from countries where cotton is gr almost virgin soils, or cultivated intelligent planters, and to attempt these kinds of cotton at once into g tion in South India, on impoveris tilled, unmanured soils. Before su cotton can be grown in South Indi there must be a very great impr character of the husbandry gener In a few favoured localities, in vario country, the conditions necessary fo culture of the higher races of the co undoubtedly be secured; but th favourably circumstanced is already utilised.

However, as I have already state Department effected much good. now, in certain districts in South I of cotton introduced and acclim department, which, though n-uch

perior to any indigenous cotton; while be no doubt that the immense quantity cotton seed distributed over the country d much good in indigenous cotton, by ing with it.

under which the Cotton Department ssed, was that the department was not success—that its income did not meet s; as if this was the standard by which of the operations conducted were to be never can understand why in India this hould be applied only to enterprises their object the improvement of agri- Vere the same standard applied to the he working of the various departments te, in determining the claim of these s for continued existence, I fear they no better ground to exist longer than efunct Cotton Department; while, in y, that great institution, the South Museum, which is doing so much for on of the British public, the equally institution at Kew, would have to be were their results judged of by this ig standard. It is true that the out- successful agricultural enterprise must, , be a gain, but it does not follow that an be made to assume a money form e.

any difficulties encountered in conduct- rk of the Cotton Department, not the le suspicion with which its operations l by the ryots generally. They could le it possible that a Government, influenced only by ordinary commercial ld act, as it were, disinterestedly. In ices they not only refused the use of for the experiments, though a liberal pensation was offered, but not unfre- used to accept, for sowing, superior when offered free of all charge. They ly to believe that the sole object of t in giving attention to cotton culture, reason for raising the rent of the land. closing of the Cotton Department, the lrew from all active interference in vation, and, for some years, but little y the State in any other direction to- ultural improvement. A few isolated s were conducted here and there under ectors, notably the late Mr. John Sul- in the Coimbatore Collectorate, con- ny useful agricultural experiments, the introduction of new crops on the en constituting a portion of the Coim- rict. Amongst other crops he intro- , was a variety of wheat obtained from , which at one time was largely culti- ese hills, and, even now, is grown to t there. This gentleman also introduced several crops now well established on Hills. But, generally, the experiments by collectors at this period seldom ults of a useful nature, not so much of knowledge or want of interest on collectors, but from want of leisure to periments the required attention, and equency with which they were trans- her collectorates.

ral shows have been held in various parts of South India, with a view to the promotion of agricultural improvement. About twenty-five years ago, shows of this nature were frequently held in the different districts. At these shows prizes were offered for good specimens of agricultural stock, field produce, agricultural implements, tools, &c. The shows were held at the head-quarters of the collectorates. The prizes were numerous, but small in amount. The average cost of such a show was about £200, the whole of which was provided by Government. In the districts of South India, among a people so backward as are the rural classes there, generally, the holding of agricultural shows could not but be attended with advantage. But the shows were, at first, undoubtedly looked upon with great suspicion by the agricultural classes. The Revenue Board of the Presidency, in referring to one of these provincial shows observed, "The committee at Cuddapah had great difficulties to contend with, and experienced considerable opposition. The show, therefore, can be regarded as having effected little more than dissipated the suspicions and fears of the people." Afterwards, in referring to the results of the first series of these shows, the Board remarked, "The provincial exhibitions, generally, have been as successful as, under all circumstances, could have been expected." About three or four years later (1859), a number of provincial agricultural shows were again held in Madras, fifteen having been held in that year, at a cost of about 35,000 rupees. The results of these shows, appeared to have been considered disappointing, for the Board of Revenue, who again had the control and general management of the shows, thus wrote:—

"On the present occasion, long notice was given, and full publicity ensured. The sum placed by Government at the disposal of the local committees was ample, and liberal prizes were offered for competition. The Board regret, however, to state that, with few exceptions, the result has not been satisfactory. The novelty of the thing has, to a great extent, worn off; the preconceived idea, of the majority of the exhibitors, apparently, that the trouble of producing a specimen was in all cases deserving of reward, without reference to the character of the article, and their corresponding disappointment, the depreciating accounts of unsuccessful competitors, the fear of cholera, and, in some instances, the superstitious belief that the unfavourable seasons of late years were to some extent produced by the 'evil eye' of those to whom the produce of their labours was publicly exhibited, have combined to produce this result. The interest, however, of the spectators seems to have been unabated, and that good has resulted from the movement the Board believe. The cultivation of valuable special products has been extended, and in some cases originated—improvements in farming, in cattle breeding, and in implements, have been encouraged, and some acquaintance with the advantages of machinery afforded. Some branches of manufacture, which promise to be valuable, have been developed, especially in fibres, and it may confidently be expected that the seeds of emulation and enterprise that have been sown will bear fruit in the future."

If the results mentioned in the latter part of this quotation were really as stated, I venture to think that these provincial shows were successful, and that they ought to have been continued from year to year.

During the last 20 years, but very little has been done in holding agricultural shows. Two have

been held near the City of Madras, and one on the Nilgiris, and one or two in other districts; but none since 1874. In one district, that of Nellore, cattle shows were held for several years in succession; but these also have been discontinued. At the present time, therefore, this highly important means of improving agriculture is altogether unemployed in South India.

In England, with its highly advanced agriculture, we have in every county an agricultural association, and in many counties several district or local agricultural societies, all actively at work in promoting agricultural progress. These associations and societies in the British isles spend annually very little less than half a million pounds sterling; an expenditure which, I think, can be justified on strictly commercial principles, and yet, according to the present Indian official view, such an expenditure would be considered unjustifiable. I am strongly of opinion that agricultural shows should be held annually in every district of South India. The cost would be but trifling compared with the vast revenue the land yields the State, and I am confident that eventually satisfactory results would be secured. For a time we must be content to sow, feeling assured that, if proper means are taken, a harvest of good results will certainly follow. Agriculturists are slow everywhere in adopting improvements. It is unfortunate that, in dealing with the great question of agricultural reform in India, narrow-minded, unintelligent views have been allowed to crush the germs of reform. The matter must be viewed from the same standpoint as ordinary educational efforts. If the expenditure of £100,000 a year on literary education in South India is justifiable, surely the expenditure of a few thousand pounds annually over that country, in promoting the material interest of the classes amongst whom we are so anxious to create M.A.'s and B.A.'s is, to say the least, equally justifiable. But, then, our land administrators are "classical scholars," not agriculturists, and their panacea for the deplorable state of the agricultural classes—and, let it be remembered, India is essentially an agricultural country—is education in Greek and Latin.

When Sir William Denison became Governor of Madras, attention was again directed to agricultural improvement, and this was kept up until Lord Napier, who succeeded Sir William Denison, ceased to be the Governor of the Presidency. A large number of agricultural implements and machines were then purchased in this country, but, when they arrived in India, it was found that they could not be worked under suitable conditions, Government then having no suitable land under its direct control on which the machines could be worked. The necessity for testing these machines, &c., under proper superintendence, suggested to the authorities in 1865, the propriety of establishing a Government farm; and a piece of land of about 300 acres, situated about six miles to the south of Madras, which was then covered by a prickly-pear jungle, was selected as the site of the farm. The selection was made because the land was the property of Government, and because the medical authorities had declared that it was absolutely necessary to clear the land, as in its then state it was the cause of much fever in the neighbouring town of Saidapet. A committee of Governm
was appointed to manage the farm
operations were confined to clearing
of land, sufficient to afford opportunitie
field implements, chiefly light ploughs.
years after opening the farm, but littl
beyond clearing the prickly-pear jun
out the land in fields, making roads, a
cattle-sheds. The committee got tog
useful varieties of farm stock, and condu
small experiments in growing new c
their attention was chiefly confined to
of which they imported several useful
this period of the farm's existence, th
of its conductors was simply to show
pean implements of a suitable kin
worked with success by the cattle of t
They also gave attention to water-lif
they purchased and erected several
kinds for experimental trials.

In 1871, this committee was abolisl
general control of the farm was give
Presidency Board of Revenue. It w
posed that the farm at Saidapet s
central experimental station, with br
mental stations in each district of the
the whole to be conducted by a small
then organised, with head-quarters
The objects to be kept in view by the
were specified by Government to be as

(1.) To ascertain, by experiment, th
of rotation in crops in this country.

(2.) To introduce the system of r
crops, in lieu of fallow, without artifici

(3.) To introduce new crops.

(4.) To provide new kinds of seed
seed for the crops now cultivated.

(5.) To make experiments in the use
the cultivation of crops now termed '
and for raising grasses and other cro
as fodder.

(6.) To make experiments in the us
other manures, mineral and animal.

(7.) To introduce new and improved
of rural labour.

(8.) To improve the working c
horses, and other varieties of live s
country.

These objects have been steadily ke
the management of the department,
very limited means permitted, or as th
authorities would allow.

The first difficulty that present
attempting to carry out the schen
absence of qualified natives, who alon
placed in charge of the district station
this difficulty, Government authorised
tainment, at Saidapet, of a number of
were to be trained there, for employ
wards as superintendents of these stati
youths were to become qualified for t
duties merely by taking part in the ordi
tions of the farm. Though liberal st
offered, and promises were held ou
employment on liberal salaries, no we
youth, of the stamp required, could be
join this apprentice class. The fact w
culture was at that time known to
generally, it was estimated a pursuit of
the unintelligent portion of the com

ormed of the sons of subordinate officials , who duly appreciated the high stipends month) offered, but it was soon ascer- ; mere field-training would never fit sort forming the class to hold the position of superintendents of experi- ions. After a very full trial, the fact ised—a fact well known before to those with the subject—that in order to pro- ied native superintendents for the erimental stations, it was absolutely secure well educated youths, and to n to a prolonged training of a syste- In this view, the Revenue Board of ly concurred, as the following extract their published proceedings shows:—

unless systematic instruction in agriculture ices bearing on it is given at the Saidapet ent superintendents for the experimental are to be instituted, cannot be trained

; without superintendents trained in this erimental farms will be of little or no use. the means for giving such a training, , the students, and the opportunities for hat is taught, and the funds, are all

t the good effects of the instruction will l to a few superintendents of Government rill slowly leaven the agriculture of the y, as in England, America, France, and

; as a scene of systematic instruction open , the Saidapet farm will be infinitely more public than it is at present."

ly after a great expenditure of time n discussing the question, that a re- sent was obtained for the establish- agricultural college, on a small scale, in which youths could be trained for :, as superintendents of district ex- stations, and agricultural instructors; employment, &c. A comprehensive organised, and its details extensively the form of a prospectus. Though ion was originated in view to train superintendents, &c., no inducements s were held out of State employment who passed successfully through the Indeed, there was a nervous anxiety that every candidate should clearly that, in qualifying as an agriculturist tution, he would thereby establish no ever on Government. In connection titution, 24 bursaries were established, about £15 a year, and tenable years of the three years of training. saries could only be got and re- really industrious students, after six ndance at the college, and who con- ng their whole course of training to the standard of progress laid down. A um of marks was to be gained at each nty or more examinations of each ile evidence of a thorough practical e with the working of ploughs and mplements was insisted on. ufficient time had elapsed to allow of gh publication of the prospectus, and cussion in the native press of the objects of the new institution, applications from would-be candidates began to be received in considerable numbers, and from nearly all parts of India. No candidate was accepted who had not qualified in the educational standard prescribed for ordinary State employment, or for proceeding to a University degree, or who failed to pass the special (equally difficult) entrance examination of the college. All candidates had to produce medical certificates of physical fitness for active employment, certificates of character, &c., and each candidate selected was between the ages of 18 and 24.

Notwithstanding the previous repeated failures in filling the apprentice classes, when such substantial advantages were offered, there was no difficulty now in securing any number of qualified, educated youths. The institution began work in 1876, with a first class, in temporary sheds. The erection of commodious but unpretentious buildings was sanctioned, in which to carry on the work of the institution. The permanent accommodation was to consist of lecture-rooms, class-rooms, a reading-room, and a library; and separate buildings were to provide accommodation for a veterinary hospital and a chemical laboratory; while, in addition to the farm, botanical grounds were to be established; but only the chemical laboratory has yet been erected. The nature of the training afforded by the institution, will be gathered from the following extracts from the college prospectus:—

"The instruction given in the institution will embrace a thorough study of agriculture, and of such portions of chemistry, geology, zoology, botany, and the veterinary art as bear on the theory and practice of agriculture. In addition to these special subjects, the following will also receive attention:—Farm book-keeping, land surveying, mensuration, and drawing. The instruction will be given by means of lectures, class-room discussions, and field classes.

"During the portion of the day set apart for practical instruction in farming out of doors, every student will be expected to take part in whatever work is going forward on the farm; compliance with this regulation will be strictly enforced. Each student will be expected to make himself acquainted with all the operations daily performed on the farm, and will be required to keep a journal or diary of the same."

In 1878, a second class was formed, and applications for admission into it were even more numerous than they were for admission into the first class. That there was a widespread demand for agricultural instruction was amply evident.

In reviewing the work of the institution at this period, after it had been at work for nearly three years, the Government of the Presidency, in a published order, stated, "the progress and working of the institution have, on the whole, been very satisfactory."

A change of policy, however, took place at about this time in the treatment of the institution, partly under the influence of the general State policy of reduction of expenditure, from which that department suffered. And of the twenty-four bursaries attached to the institution, nine were then suppressed, and these were afterwards reduced to five only in a class; while the value of the bursaries was reduced from about £12 to £8 per annum. The entire saving to the State by these reductions would amount to only about £100 a-year; but the effect, combined with other causes, was highly injurious to the institu-

tion, for, when it was again attempted to form a new class, only seven eligible candidates were secured.

The practice of paying stipends, or bursaries, to youths undergoing special training, is almost universal in India, in the Medical, Forest, Educational, and Engineering Departments. Very few students from the agricultural districts can afford the expense of journeys, frequently long, and the cost of maintenance away from their homes, during a three years' college course. The provision of bursaries to aid indigent able students, is as necessary, to say the least, in South India, as in Scotland, Ireland, or England. A time may, it is hoped, arrive when agricultural education in India may not require to be aided in this way; but as long as such aid is necessary in every civilised country, it surely was premature to withdraw such aid from the but recently started agricultural institution in Madras.

Only one class of students has completed the full period of training in the Madras College. Of these young men, the majority are filling agricultural situations, and generally with credit; eight of them are employed as agricultural instructors in the Bombay Presidency; but, in Madras, none of the graduates of the college have yet been employed by Government, though there were several well fitted, after undergoing a little special training for the posts of agricultural instructors, and for superintendents of experimental stations, the establishment of which has been deferred so long from the impracticability of previously getting qualified native superintendents.

(To be continued.)

MISCELLANEOUS.

XANTHORRHŒA RESINS.

A paper was read by Mr. J. M. Maisch on these resins, at the Philadelphia Pharmaceutical meeting of April 19th last, which is reported in the *American Journal of Pharmacy*. The author, after having seen a resin exhibited as a new Australian product, under the name of Gum acroides, discovered that the supposed new commercial article had been known in the United States for upwards of 25 years, and was, in fact, identical with Botany Bay resin.

"The genus *Xanthorrhœa* belongs to the natural order of *Liliaceæ*, is confined to Australia, and consists of shrubby, or arborescent plants, somewhat palm-like in appearance, and having at the summit dense tufts of very long, wiry, narrow, two-edged, or somewhat triangular, leaves, resembling grass leaves; hence the name *grass-trees*, by which the species are known in Australia. The leaves are used as fodder for cattle, and the somewhat sheathing base of the inner leaves and the buds are eatable, and form, particularly when roasted, an agreeable article of food. From the centre of the leaf tuft, there rises a long cylindrical scape, which terminates with a long spike of small white flowers, situated in the axils of the imbricate bracts, and producing triangular three-celled capsules, containing flattish, hard, black seeds.

"R. Brown (1801) described seven species, viz., *X. arborea*, *australis*, *hastilis*, *media*, *minor*, *bracteata*, and *pumilio*. The two first-named species are arborescent, while the third and fourth have short stems, that of *X. hastilis* being about 4 feet high, and is said to sometimes attain a diameter of 1 foot, and then is probably more than a century old, owing to its slow g The last three species named before are stemle the stems remain buried in the soil or rise scarcel ground.

"All the species abound in a resinous juice, wh exposure, hardens, and as obtained from the d species, undoubtedly differs in appearance and composition. Guibourt distinguishes three resi resins—one yellow, one brown, and one red. T coloured resin is still ascribed by some auth *hastilis*, but Drummond (1840) pointed out arborescent species, probably *X. arborea*, is in called 'black boy,' and the Pharmaceutical S Victoria state that *X. australis* (which is ar yields a large quantity of a brilliant ruby resin. On the other hand, the botanist Sc the yellow resin to *X. hastilis* and some oth The last named is the *X. resinosa* of Persoon *Acaroides resinifera* is quoted as a synonym 'Supplement.' The name acaroid resin i plained. The different xanthorrhœa resins described more especially in regard to th papers by Mr. Redford, as a polishing *American Journal of Pharmacy*, 1863, p. 45 by Mr. P. L. Simmonds, in the same jo p. 226 to 228, and in 1866, p. 465 to 468; last quoted refer chiefly to the use of the manufacture of illuminating gas. The res be obtained as natural exudations, the su portions of the plant producing them in s at least, apparently in great abundance; also found covering the base of the leav secreted in such quantity in the woody stem crushing the latter, it may be sifted from the extent of a hundredweight per d labourer.

"The acaroid resin, which was first not by Governor Phillip (' Voyage to Botany with in tears and in large masses usually, of its brittleness, broken into irregular p intermixed with portions of wood, stalks and when fractured has a speckled or grani The pure resin is reddish yellow; the article is externally brownish yellow, an opaque and of a pure yellow colour, resem gamboge, but always much lighter. description by Guibourt agrees with the sented here; but since the resin is desc authors as being of a deeper yellow than g evident that it must be sometimes co different species. Triturated with wat form an emulsion. When fresh it h analogous to that of poplar buds, but agreeable (Guibourt); the odour appears very nearly that of benzoin mixed w storax. By age the odour becomes gradually disappears, but it is always powdering or by fusion. The resin dissolv leaving only 0·07 of a gum insoluble i analogous to bassorin. When heated it gi vapours, condensing into brilliant small l Laugier regarded as benzoic acid, but wh (1848) found to consist largely of cinnamic

"The brown resin has a more balsamic o preceding; the tears are roundish, extern brown, and resembling dragon's blood; ture is shining, glass-like, and in thin s perfectly transparent, and of a hyacinth-re is completely soluble in alcohol, and co volatile oil, rendering it viscous and somew

"The red resin is in distinct tears of a red, and sometimes externally bright red is glass-like; thin splinters are transpare red; it is completely soluble in alcohol, intermixtures excepted, and its balsamic o always apparent on heating.

g the composition of the xanthorrhœa quotes the analysis of Lichtenstein (1799), ugier, Wiedemann (1825), Trommsdorff enhouse (1848). Heated with manganic binphuric acid, acaroid resin evolves the odour almonds, and by the action of nitric acid it proportion of carbazotic (picric) acid with zoic and oxalic acid (Stenhouse). Trommsthe volatile oil to be colourless, fragrant, gent aromatic taste. The resin is soluble the alkalies and alkaline earths. On dry uch carbolic acid is obtained, with a small light oil, but, according to Sommer, no In 1866, Hlasiwetz and Barth ascertained esin on being treated with fusing potassa uantities of paraoxybenzoic acid, and from quor of the ethereal solution a little resorcin hin was obtained, together with the double protocatechuic and paraoxybenzoic acids= I_2O, which had been previously obtained

ferent xanthorrhœa resins were found by 877) to be incompletely soluble in chloroer, but to dissolve completely in alcohol, acquiring a brown-black colour with ferric e solution of the acaroid resin is yellow, ith lead acetate a precipitate, while the the other two resins are red, that of X. being not disturbed by acetate of lead, X. *arborea* produces with the same reagent the chloroformic solution of the latter is f the former colourless.

thorrhœa resins have been repeatedly possessing some value in perfumery; but o be inferior for this purpose to benzoin, the balsams of Peru and Tolu. Their operties appear to be likewise not well early as 1795, experiments were made on , for the purpose of learning their properth (*Boston Journal*, x., p. 94) employed it of tincture, with opium, in phthisis, and it mmended in chronic catarrhs. A tincture sin, mixed with milk or a mucilaginous oen recommended to be made of equal e resin and alcohol."

TION OF THE AUSTRALIAN DESERT.

n the geological and zoological features of parts of South Australia, by Mr. E. B. been lately issued, from which the follow- in *Colonies and India*, showing that there been considerable misapprehension as to the reat Australian Desert":—

e Gums to Manuwaukaninna the country tony tablelands, alternating with alluvial borders of the tablelands are generally the central portions; thus, when seen from ey assume the appearance of low flat-topped plain is intersected by one or more waterfor the greater part of the year, or at any up into a few waterholes. The watera general westerly flow, and after a certain ier run out altogether or expand into a , as it is called, a lake; one or two of the aid to empty into Lake Eyre. When the sets in, or even after a heavy shower, they and, overflowing their banks, spread over ats, forming the so-called 'lakes.' The gradually drains away, leaving the flats Some, however, of the flats, being situated vel than the others, have water over them r round, as, for example, Lake Harry. rainfall has been *nil*, or, at least, very small, for two or three successive seasons, as is often the case, these last-named lakes soon grow salt and unfit for drinking. This is explained by the fact that the flood-waters wash out from the rocks and hold in solution a large percentage of the chlorides, carbonates, and sulphates of sodium, calcium, and magnesium. Accordingly, when the water is spread out over a large surface, as on the flood-flats, evaporation takes place very rapidly, until concentration occurs to such a degree that the water is unfit for use. When, however, a new flood comes down or a heavy rain occurs, the lakes assume their pristine freshness. The most interesting feature of the tableland country to a geologist is the enormous effect of denudation. Every flood brings down a vast amount of detritus, and deposits it over the plains. In some places the alluvial deposits attain a thickness of 50 or 60 feet. On the tablelands the destructive effects of denudation are seen better still. One cannot but be surprised when one looks over the immense heaps of water-worn stones lying everywhere, and forming a talus to every cliff, and reflects upon the apparently small causes that have been able to produce such large results. One is necessarily impressed with the vast amount of time it must have taken.

"On the tablelands vegetation is comparatively poor, consisting of stunted shrubs and trees. But, desolate as it appears, after rain grass springs up with amazing rapidity, and what a short time before was a desert of stones, become clothed in a garment of brilliant green. It is, however, on the rich alluvial plains that the vegetation is the most luxuriant and the best pasture found. North of Manuwaukaninna the appearance of the country changes completely. The stony tablelands disappear, and in their place low ridges of dazzling white sandhills stretch away for hundreds of miles to the north and west. Here commences what has been called the Central Desert of Australia. The term desert, however, should be used with caution. No one seeing the sandhill country after a heavy rain would venture to call it a desert. It must be admitted, however, that during the long periods of drought it is indeed but little more than a second edition of Sahara. It is owing to the great difference in the appearance of the country in the wet season and its aspect in the dry season, that discrepancies have arisen between the reports of persons who have explored the region. Some have described the interior as a veritable desert, and others as a magnificent country, peculiarly adapted to pasture.

"The sandhills have a general north and south trend. A peculiarity worthy of note, and which will be explained further on, is that the western sides are invariably sloping and the eastern sides abrupt. Between the sandhills are flood-flats, similar to those we have described as alternating with the stony tablelands, and, like the latter, are periodically flooded by the overflowing of the creeks that wind through them. The flood-water is generally not of local origin, as in the tableland country, but is the result of heavy rains in the tropics far to the north. The surplus flood-water from the tropics backs down the Cooper, Diamantina, and the network of watercourses which connect them, and ramify through the country, and slowly fills the lakes and flood-flats. This happens, to a certain extent, every year. The Cooper and other creeks are then said to 'run.' This overflow of tropical rains reaches annually as far down the Cooper as Coongie, but it is only an exceptional flood that causes the Cooper to run below Coongie and fill the large lakes between there and Manuwaukaninna—*i.e.*, Lake Hope, Lake Perigundi, and Lake McKinlay. As a matter of course, in seasons of prolonged drought, the above-mentioned lakes become salt. Occasionally heavy local rains freshen the water of the lakes and fill the waterholes in the creeks, but never, as far as I am able to ascertain, cause a flood. The alluvial deposits necessarily differ in character from those of the tableland

country. The former are composed for the most part of a red gritty clay, while the latter are stiff blue marls. These two clays may be said, to a certain extent, to be characteristic of the two regions. Where the red gritty clay is found, the old palæozoic rocks may be looked for. The blue freshwater marl is only met with in the sand-hill country. The explanation of this difference is at once apparent when the nature of the rocks from whence the alluvium is derived is examined. On the one hand it is derived from schistose, slaty and porphyrytic rocks, with veins of black oxide of iron, which last when washed out by the water oxidises, forming the red oxide of iron which gives the alluvium its red colour; on the other hand it is derived from the tertiary sand and limestones, and mixed with a large amount of decaying vegetation. We have spoken of the arrangement of the sandhills in parallel ridges having a north and south trend, and also of the sloping character of the western side and the abruptness of the eastern side. These facts will serve to throw some light upon the origin of sandhills. After any windy day, if we look at a stretch of land where the wind has had free access, it will be found that the sand is thrown into series of small ridges or ripples, whose long axes are transverse to the direction from which the wind blows. On examining them closer it will be seen that the side towards the wind is sloping, and the opposite side abrupt. Here again, we have in miniature the whole sandhill country. Now, the same cause that made the land ripples has made the hills, and that is the wind. In the one case it took a day, in the other it has taken many centuries, to produce the result. The prevailing winds throughout the region are westerly, and, as we should expect, the sandhills tend north and south. And, again, the sloping side of the sandhills face towards the wind. The sandhills of the country, in fact, indicate the direction of the prevailing wind. No fact is impressed more strongly upon a geologist than this—that it is with comparatively small means that nature produces the greatest results. Whether it is the upheaval of the Alps, or the subsidence of the coral basin of the Pacific, the levelling of mountain ranges or the filling-in of ocean basins, in all apparently small causes produce the result—in all the same grand impassive uniformity is displayed."

FAURE'S SECONDARY BATTERY.

Sir William Thomson, F.R.S., has written the following letter to the *Times*, containing the results of his experiments with Mons. Faure's battery, described in the *Journal* of May 20th (p. 576):—

The marvellous "box of electricity" described in a letter to you, which was published in the *Times* of May 16th, has been subjected to a variety of trials and measurements in my laboratory for three weeks, and I think it may interest your readers to learn that the results show your correspondent to have been by no means too enthusiastic as to its great practical value. I am continuing my experiments to learn the behaviour of the Faure battery in varied circumstances, and to do what I can towards finding the best way of arranging it for the different kinds of service to which it is to be applied. At the request of the Conseil d'Administration of the Société de la Force et la Lumière, I have gladly undertaken this work, because the subject is one in which I feel intensely interested, seeing in it a realisation of the most ardently and unceasingly felt scientific aspiration of my life—an aspiration which I scarcely dared to expect or to hope to live to see realised.

The problem of converting energy into a preservable and storable form, and of laying it up in store conveniently for allowing it to be used at any time when wanted, is one of the most interesting and important in the whole range of science. It is solved on a small scale in winding up a watch, in drawing compressing air into the receiver of an air-[illegible] Whitehead torpedo, in winding up the we[illegible] clock or other machine driven by weigh[illegible] pumping up water to a height by a windmil[illegible] wise, as in Sir William Armstrong's hydraul[illegible] lator) for the purpose of using it afterw[illegible] work by a waterwheel or water pressure o[illegible] It is solved on a large scale by the [illegible] of burning fuel to smelt zinc, to be after[illegible] to give electric light or to drive an electr[illegible] engine, by becoming, as it were, unsmelted i[illegible] battery. Ever since Joule, 40 years ago, f[illegible] thermodynamic theory of the voltaic batte[illegible] electro-magnetic engine, the idea of applying to work the battery backwards, and thus [illegible] chemical energy to the materials, so that they act voltaicly, and again and again, has been [illegible] science. But with all ordinary forms of volt[illegible] the realisation of the idea to any purpose see[illegible] lessly distant. By Planté's admirable disco[illegible] lead and peroxide of lead voltaic battery, all[illegible] your correspondent, an important advance t[illegible] desired object was made 20 years ago; and [illegible] Faure's improvement practical fruition is at[illegible]

The "million of foot pounds" kept in the [illegible] its 72 hours' journey from Paris to Glasg[illegible] exaggeration. One of the four cells, after charged, was recharged again by its own battery, and then left to itself absolutely [illegible] for ten days. After that it yielded to me 2[illegible] pounds (or a little more than a quarter of [illegible] This not only confirms M. Reynier's measur[illegible] the faith of which your correspondent's sta[illegible] made; it seems further to show that the waste[illegible] energy by time is not great, and that for day[illegible] at all events, it may not be of practical mom[illegible] however, is a question which can only be answe[illegible] ful observations and measurements carried on longer time than I have hitherto had for in[illegible] the Faure battery. I have already ascertai[illegible] regarding its qualities to make it quite cert[illegible] solves the problem of storing electric energy [illegible] and on a scale useful for many importa[illegible] applications. It has already had in this [illegible] interesting application, of the smallest in [illegible] dynamical energy used, but not of the sma[illegible] spect to beneficence, of all that may be exp[illegible] A few days ago my colleague, Profes[illegible] Buchanan, carried away from my laborator[illegible] lead cells (weighing about 18 lb.) in his ca[illegible] by it ignited the thick platinum wire of [illegible] *écraseur*, and bloodlessly removed a nævoid t[illegible] the tongue of a young boy in about a min[illegible] The operation would have occupied over ten performed by the ordinary chain *écraseur*, have been had the Faure cell not been av[illegible] cause in the circumstances the surgical elect[illegible] his paraphernalia of voltaic battery to be set hand, would not have been practically admis[illegible]

The largest useful application waiting ju[illegible] the Faure battery—and it is to be hoped tha[illegible] *minimum* of time will be allowed to pa[illegible] battery is supplied for this application—is to electric light what a water cistern in a hou[illegible] an inconsistent water supply. A little batte[illegible] of the boxes described by your correspondent give the incandescence in Swan or Edison li[illegible] extent of 100 candles for six hours, withou[illegible] ceptible diminution of brilliancy. Thus, i[illegible] needing a gas-engine or steam-engine to k[illegible] work as long as the light is wanted, with th[illegible] of the light failing at any moment through th[illegible] of a belt—an accident of too frequent occu[illegible] any other breakdown or stoppage of the [illegible] and instead of the wasteful inactivit[illegible] the hours of day or night when [illegible]

equired, the engine may be kept going all stopped at night, or it may be kept going day it, which will undoubtedly be the most econo- in when the electric light comes into general use. The Faure accumulator, always kept from the engine by the house-supply wire, with automatic stop to check the supply when the itor is full, will be always ready at any hour of or night to give whatever light is required. the same advantages in respect of force will l by the accumulator when the electric town- , as it surely will be before many years pass, used for turning lathes and other machinery hops and sewing machines in private houses. er very important application of the accumulator electric lighting of steamships. A dynamo- machine of very moderate magnitude and driven by a belt from a drum on the main rking through the 24 hours, will keep a Faure itor full; and thus, notwithstanding irregu- f the speed of the engine at sea, or occasional s, the supply of electricity will always be ready iwan or Edison lamps in the engine-room and r arc lights for mast-head and red and green ps, with more certainty and regularity than been achieved in the gas supply for any house *irma*.

t apologise for trespassing so largely on your Iy apology is that the subject is exciting great mong the public, and that even so slight an it of information and suggestions as I venture a this letter may be acceptable to some of your -I remain, your obedient servant,

WILLIAM THOMSON.

versity, Glasgow, June 6.

HENRY COLE ON TONIC SOL-FA.

: annual meeting of the Tonic Sol-fa College, Monday evening, May 30th, at Exeter-hall, the i (Sir Henry Cole, K.C.B.), said he would speech by prophesying that the Tonic Sol-fa rould become the 'universal method of teach- ; in the public schools of the United Kingdom, be first step in the national cultivation of nd he continued, "Am I justified in making ment? I will try to justify it, and, with your count for my presence here. I crave your whilst I unravel the threads of my reasons, and the sequence of atoms of facts which have me before you as the advocate of the Tonic thod, of which I knew very little three months which I now am persuaded, upon the best and with such judgment as I can put upon it, the best method of introducing music gene- this country. I am no musician, but at ten I did what many of you do—played the flute; ument then worked by the fingers, and not by t is at the present time. I also at one time took ssoon, and fifty years ago, at the instigation of ohn Stuart Mill, I attempted to play the piano- with very trifling success. Then I plunged into ial study of harmony, and particularly of Colonel 's work. Of course with that great amount of e I became a musical critic. I witnessed the blache's first appearance at the Italian opera, was assisted by Malibran, who was then a divinity, and I may say by the way, that a r I saw the first appearance of Taglioni, who, newspapers said, floated on the stage like rn. I then took some lessons in singing, having begotten children, I became an editor onal nursery songs. Fifty years ago there was mentary grant for national education. There ach singing in our churches as we have now. If u know the South Kensington Museum you will a picture there by Thomas Webster, which is called 'The Village Choir,' and if you want to know what village choirs were fifty years ago look at that picture. Somebody said it was a Protestant version of the Gregorian chant, but it will give you an idea of how music was cultivated in our churches at that time. There was no Sacred Harmonic Society, which came to this hall, and has gone. Exeter-hall was not even built then. There was no such great organisations for public singing as now exists. The Tonic Sol-fa system, although invented, was not heard of publicly. In 1871, however, vocal music in elementary schools was introduced into the Code—you know what the Code is, some of you; at least, I hope you do—it was introduced into the Code by Mr. Forster, to whom the nation mainly owes the introduction of national education. He introduced those words, 'vocal music,' into the Education Code of 1871; but before him, more than twenty years before, Dr. Kay (afterwards Sir J. Kay-Shuttleworth) had taken up the matter as far as the teachers' certificates were concerned, and Dr. Hullah even then looked after the music, and the teachers were credited with musical honours if they deserved them. Now—you will hardly believe it, those who do not know the mystery of the thing—the teachers get no credit for music at all in their certificates. You, the taxpayers, vote through your representatives £136,000 a year for bad singing—I will not call it music—and yet the teacher who has to impart this knowledge is not recognised as knowing anything about it. After these words 'vocal music' were brought into the Code, Lord Sandon—Heaven knows why—took them out and put in 'singing by ear.' In a fit of desire for popularity he reduced 'vocal music' to 'singing by ear.' Lord George Hamilton succeeded him, and he restored the words 'vocal music' and kept 'singing' also. It was ruled—'If you can pass in the Tonic Sol-fa method you can have the 1s. for vocal music, but if you only sing by ear you shall only have half the grant you get for vocal music.' Now, there is a mystery about the next change which 'no fellow can understand.' Mr. Mundella, whose zeal for education no one can doubt, immediately on coming to power, expunged 'vocal music' again. The teachers are still examined in music, and very well examined by Dr. Hullah, but they get no credit for it, and the managers of schools are told nothing about it in the certificates—the knowledge of music is not recorded in the certificate at all. Dr. Kay, who was the organiser of our national education, was the man who put it in; but who persuaded my Lords to put it out, is a mystery which nobody can fathom. Now let me speak briefly about our various academies for musical education. First we have the Royal Academy of Music, which at first led a struggling life, but by putting its shoulder to the wheel it has got out of difficulty, and is now a very flourishing institution, with its £13,000 a year. Since the Royal Academy was established, there has been a National Training School of Music established by the Society of Arts, which is doing its work fairly well, but both these institutions are bound to begin with the Tonic Sol-fa method, and to use the College for their purpose. Whilst the Tonic Sol-fa system was marching on in triumphant progress, every other system seemed on the whole to be going back. They had 29,000 schools that might be taught the Tonic Sol-fa method. They had only 1,300 taught by the Hullah, or the old notation, or the movable Doh, or anything else, but the Tonic Sol-fa, as they heard from the report, had more than 4,000 teachers, and before it had done its work in England it must get up to that 30,000, and it would do so. It is the easiest and most scientific system to begin with; it leads easily to the old notation. It is supported by such authorities as Professor Macfarren, Dr. Sullivan, Dr. Stainer, and, in fact, by every musician who will trouble himself to understand it. It will greatly aid the work of the Society of Arts in the national cultivation of music. May it prosper!"

CORRESPONDENCE.

MANUFACTURES, TRADE, AND PROGRESS OF ENGLAND.

When the founders of the Society of Arts established our Society, above a hundred years ago, for the encouragement of Arts, Manufactures, and Commerce, they did so to provide for the growing wants of our internal development, and also of our rising colonial empire. That design was so well laid, and has been so successfully carried on, that we are still actively engaged in its prosecution.

In that period, and particularly of later time, our external trade, on which the maintenance of our population chiefly depends, has acquired enormous proportions, but it is subjected to a most keen competition. Indeed the world is under new conditions. The provinces of America, which at our foundation may have had a million of people, showed at the census of last year above sixty millions of our English speaking men in the United States. They are consumers, it is true, of our manufactures, but still more active competitors after our own ways. Then, too, Europe is ever ready to compete with us.

Concurrently with the existence of our own Society, there have been established, partly by ourselves, many valuable institutions for the advancement of industry, not only Chambers of Commerce, but others, such as the Iron and Steel Institute, for technical improvement. Our own means and strength do not allow us to do the whole of this work, but only to co-operate in it, and they do not enable us to take charge of the general relations of our industry abroad.

At this time, as we deeply feel, we are being driven out of many a country by our American and foreign rivals, and, in some cases, the capital for these operations is obtained in our own market. Thus an American, a Belgian, or a Frenchman obtains the concession of some railway or public works, he places the securities in this country, and with the proceeds he obtains the iron, machinery, and plant from abroad, displacing us.

This is only one class of numerous operations illustrative of what is now going on, chiefly because there is no organisation of our industry, and not even a Ministry to look after our commerce abroad. Free trade does not mean free neglect of trade. To enter into the subject to any extent would take up great space, and only enforce facts, which come home to the bosom of every manufacturer.

Surely the time has come when some action, perhaps by the instrumentality of our Society, should take place, and when the Chambers of Commerce, the trade associations, and the individual manufacturers, miners, or merchants and shipowners should bestir themselves in convention and in concert to provide for their own and the national interests at home, in the colonies, in India, in America, and abroad, where, in many cases, some small care and assistance would preserve what is being wrested from us, or would open new markets for our products.

HYDE CLARKE.

GENERAL NOTES.

The International Medical and Sanitary Exhibition.—It is announced that the whole of the floor space for this Exhibition will be allotted this week, with the exception of a portion which the committee have decided to set apart for exhibiting the work of journeymen plumbers. Under special regulations this work will be exhibited free of charge, and it will include the specimens of workmanship produced by the competition for the prizes in connection with the lectures on plumbing now being delivered in the room of the Society of Arts. Plumbers wishing to exhibit sho[...] application for particulars to Mr. Mark Judg[...] Museum of Hygiene, University College, [...] Certificates of merit will be awarded. H.R.[...] Edinburgh has consented to become the patr[...] bition.

MEETINGS FOR THE ENSUING [...]

MONDAY, JUNE 13TH...Royal Geographical, Univ[...] Burlington-gardens, W., 8½ p.m. [...] Baber, "A Journey of Explorat[...] Szechuen."

TUESDAY, JUNE 14TH...National Health Society [...] OF THE SOCIETY OF ARTS), 7.30 p.m[...] Hellyer, "The Science and Art of San[...] (Lecture III.)

Medical and Chirurgical, 53, Berne[...] street, W., 8½ p.m.

Photographic, 5A, Pall-mall East, S.W.[...]

Anthropological Institute, 4, St. Mart[...] 8 p.m. 1. Mr. J. Park Harrison, "Exl[...] and French Photographs." 2. Majo[...] Rivers, "The Discovery of Flint I[...] Gravel of the Nile Valley, near Thebe[...] Tylor, "The Human Fossil at Nice.'[...] A. Kinahan, "Sepulchral Remains a[...] Wicklow." 5. Mr. J. H. Madge, [...] Excavations made in Tumuli, near [...] June, 1880." 6. Mr. F. E. im Thu[...] Implements from British Guiana." [...] "The Origin of the Semites."

Royal Colonial, Grosvenor Gallery I[...] Bond-street, W., 8 p.m. Mr. F. P.[...] Political Organisation of the Empire.[...]

Royal Horticultural, South Kensington[...]

WEDNESDAY, JUNE 15TH...National Health Soci[...] OF THE SOCIETY OF ARTS), 7.30 p.m[...] Hellyer, "The Science and Art of Sa[...] (Repetition of Lecture II.)

Meteorological, 25, Great George-stree[...] Mr. Charles Harding, "The use[...] Meteorological Charts for determin[...] over the Ocean." 2. Mr. Robert [...] "The Climate of Fiji." 3. Mr. J. A[...] on the Formation of Hail." 4. Mr [...] "Note on a comparison of Maxim[...] Temperature and Rainfall observed [...] and at the Royal Observatory, C[...] January and February, 1881."

THURSDAY, JUNE 16TH...Domestic Economy [...] Albert Hall, Kensington, S.W., 11.3[...] Mrs. Buckton on her "Method of [...] Economy."

Royal, Burlington-house, W., 4½ p[...] "The Differences in the Physiologic[...] by the Poisons of certain Species of [...] Snakes." 2. Dr. Brunton and Dr. [...] of Electrical Stimulation of the F[...] modification by Cold, Heat, and the [...] 3. Mr. Charles Wesendonck, "Not[...] of Carbonic Acid." 4. Dr. Brunt[...] "Action of Ammonia and its Sal[...] cyanic Acid upon Muscle and Nerv[...] Spottiswoode and J. F. Moulton, "S[...] —VI. Shadows of Striæ." 6. Mr. V[...] Influence of Coal Dust in Colliery Ex[...] 7. Prof. J. A. Ewing, "Effects of Str[...] electric Quality of Metals." (Pa[...] Papers.

Antiquaries, Burlington-house, W., 8½[...]

Linnean, Burlington-house, W., 8 p.m.[...] Aitchison, "Flora of the Kuram Vall[...] Part II. 2. Mr. Robert McLachlan, [...] of Madeira and Azores." 3. Prof. [...] W. P. Hiern, "Central African F[...] Major Serpa Pinto."

Chemical, Burlington-house, W., 8 p[...] Election of Fellows. 2. Mr. W. [...] Isomeric Acids obtained from the [...] Aldehyde and from Coumarin." 3[...] strong, "Notes on Napthalene Deriv[...] S. Johnson, "The Synthetical Produc[...] 5. Mr. S. Pickering, "The Sulphates[...]

Society for the Encouragement of Fin[...] street, W., 8 p.m. Mr. W. Cave T[...]

Royal Historical, 11, Chandos-street, W[...]

Numismatic, 4, St. Martin's-place, W[...] Meeting.

Philosophical Club, Willis's-rooms, [...] 6½ p.m.

FRIDAY, JUNE 17TH...Royal United Service Inst[...] yard, 3 p.m. Captain H. Watkin, "[...] Finders, Past and Present."

Philological, University College, W.C., [...] M. Baynes, "The Psychological Met[...] tion to Language."

OF THE SOCIETY OF ARTS.

No. 1,491. VOL. XXIX.

RIDAY, JUNE 17, 1881.

ons for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

NUAL GENERAL MEETING.

ncil hereby give notice that the One-
l Twenty-seventh Annual General Meet-
purpose of receiving the Council's
the Treasurer's statement of receipts,
nd expenditure during the past year,
or the election of officers and new
will be held, in accordance with the
n Wednesday, the 29th of June, at 4

cil think it well to call the special
Members to the above notice, and to
r hope that Members may find it con-
attend, and receive the report of the
the work of the Session.

(By Order of the Council)
H. TRUEMAN WOOD,
Secretary.

ALBERT MEDAL.

cil of the Society of Arts have awarded
Medal of the Society of the present
gust Wilhelm Hofmann, M.D., LL.D.,
fessor of Chemistry in the University
for "eminent services rendered to the
arts by his investigations in organic
and for his successful labours in pro-
cultivation of chemical education and
England."

MEDALS.

ncil have awarded the Society's Silver
the following readers of papers during
1880-81:—

: ALEXANDER GRAHAM BELL, for his paper
Photophone."
EDWARDS, for his paper on "Signalling by
Sound."
DER SIEMENS, for his paper on "The
Railway, and the Transmission of Power
city."
t Hon. Sir HENRY BARTLE EDWARD FRERE,
.B., G.C.S.I., D.C.L., LL.D., for his paper
Industrial Products of South Africa."

To J. Y. BUCHANAN, F.R.S.E., F.C.S., for his paper on "Deep Sea Investigation, and the Apparatus used in it."
To Professor JOHN PERRY, for his paper on "The Future Development of Electrical Appliances."
To Sir RICHARD TEMPLE, Bart., G.C.S.I., C.I.E., D.C.L., for his paper on "Forest Conservancy in India."
To J. M. MACLEAN, for his paper on "The Results of British Rule in India."

A vote of thanks was given to W. H. Preece (Member of Council), for his paper on "Recent Advances in Electric Lighting."

DOMESTIC ECONOMY CONGRESS.

The Domestic Economy Congress in connection with the Society of Arts will be held during the week from Monday, 20th June, to Saturday, 25th June. On Monday evening there will be a *Conversazione* and Musical Promenade in the Royal Albert-hall and Conservatory of the Royal Horticultural Society at 8 p.m. The meetings for the readings of papers and discussion will commence on Tuesday, and will be held in the Great Room of the Society on Tuesday, Friday, and Saturday, at 11 a.m., and on Wednesday and Friday evening, at 7 p.m. The meetings Wednesday morning and on Thursday will be held at the Royal Albert Hall.

Mrs. Buckton's lecture at the Royal Albert Hall will be repeated, by special desire of H.R.H. the Princess Christian of Schleswig-Holstein, on Thursday, June 23, at 4 p.m.

ART FURNITURE EXHIBITION.

The Exhibition of Works of Art Applied to Furniture, in connection with the Exhibition of Fine Arts at the Royal Albert Hall, is now open daily. A non-transferable season ticket will be sent to any member of the Society on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

EFFORTS TO IMPROVE NATIVE HUSBANDRY IN SOUTH INDIA.

By Wm. Robertson.

(*Continued from p. 620.*)

In Madras, the Educational Department is now beginning to give attention to agricultural instruction, the subject being now taught in several of the rural schools; but nothing of a comprehensive nature can be done in this way, until qualified agricultural teachers are available. And men can become so qualified only by undergoing training in the Madras Agricultural College, which, at present, is the only institution of the kind in the whole of India, and which, I venture to believe, is as fully deserving of State support as any other technical institution in the country.

I never could understand the nervous fear that appears to exist in some quarters, lest students of the college should look to State employment as affording a career in after life. The State employs, in the administration of its vast landed estate, thousands of officials of all grades, who are totally without any agricultural education. Many of these officials are employed solely in valuing the land for rent, in collecting agricultural statistics, and in many other ways connected with agriculture. Surely there can be nothing wrong in any agricultural student looking forward to employment in any of these capacities, provided he possesses, in addition to his agricultural knowledge, the qualifications all must possess who seek for such employment. I should have thought that, for the performance of agricultural duties, preference would be given to men who possess a knowledge of agriculture; but so far, graduates of the Agricultural College have encountered nothing but difficulties in seeking for State employment where a knowledge of agriculture seems essential. From what I can gather, it appears that the obstacles are put in their way chiefly by the officials of the inferior classes, who do not like the idea of better educated men than themselves getting admission into their ranks.

The Agricultural College has been organised as the central institution for agricultural training in the Presidency of Madras, and it was intended only to afford higher agricultural education. It was proposed that elementary instruction in agriculture should be afforded in the high school of each district with which the branch experimental stations were to be connected, but, as yet, none of these agricultural classes or stations have been established. The college suffers from the absence of these classes, which were intended to be its main feeders; while the course of training in it has been prolonged, from the necessity of the institution undertaking elementary as well as more advanced instruction.

Youths of the ordinary ryot class, the sons of small occupiers, will, in the agricultural classes, at the high schools and middle-class schools in the districts, meet with such facilities for gaining a knowledge of the principles of agriculture as appear suited to their requiremets. The sons of ryots of the better class, and of small zemindars, with others who desire a more complete agricultural education, will, it is proposed, pass from the local agricultural instruction classes to the college at Saidapet.

I have dwelt at considerable length, and in much detail, on the subject of establishing the Agricultural College at Madras, because I am anxious that the facts should be thoroughly known and appreciated. The experiment is one of the utmost importance in India, and it should receive fair treatment. Should any erroneous conclusions be formed regarding it, agricultural education, so much needed in that country, may be retarded for years. There are always a number of persons ready to cry out failure when anything new is being tried, and already there are persons glorying in the fact, as they assume it to be, that the college has not been a success, as if it was yet possible to form any definite conclusions on an experiment of such a nature, and conducted under so many difficulties. These persons assert that the bursaries drew the students, and that, when the bursaries

were done away with, the attrac
persons, however, altogether (
knowingly) misstate the facts. T
undoubtedly, of much benefit t
enabling them to meet the heavy
frequently long journeys to and
college and their homes at the b
of each session, and, indeed, als
personal expenses of the student
many of the students must have
more on travelling charges
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necessary. It could in no sense
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came from places more than 2
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Agricultural College, more espe
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and Engineering Departments
employment for successful stude

The Famine Commission hav
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College, and secure to it a reg
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to its working charges; for, I
that a course of lectures for a cl
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next 100 years, and the
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laced within the reach of every class of ist. The fact that the land pays four-he gross revenue of the Presidency, and thirds of the population are employed in ation of the land, should never be lost in considering questions relating to the nent of Madras agriculture.

already referred to the establishment of al Experimental Farm at Saidapet. The extract from a report submitted by me nment, shows the nature of the work in e farm is engaged:—

rm being the only one of the kind in South has, necessarily, been obliged to undertake k in experimental agriculture, of a kind not ndertaken by experimental farms in other From the almost entire absence of any writ- agriculture of the country, the ignorance of generally who are engaged in agricultural nd the imperfect character of the records of of previous efforts in improving native agri- re was no choice but to institute on the farm s of a very elementary character. It will nderstood that experience gained in this way s but very slowly, as each result needs to be nder different conditions and circumstances decided conclusions are possible. The insti- had to do the work of an acclimatisation and l society. It has been engaged in introduc- difying machines, implements, and tools of ries adapted to the requirements of Madras Attention has been given to subsoil drainage, ethods of tillage, the restoration of exhausted ilisation of irrigation water, the fertilisation oils by the use of lime, saltpetre, oil-cake, and other manures available in South India, unused by the ryot; the introduction of the uited to the climate of India, and adapted for nder an improving agricultural practice, such *rghum saccharatum*, Carolina paddy, Guinea her grasses; New Orleans and other improved cotton; tobacco of all kinds; the production of n view to affording protection, shelter, and ntroduction of water-lifts, barn-machines, ltivators, reaping knives, &c., of improved , suited after undergoing modification for use dia; the improvement of native live stock by eding and feeding, and by importing and g animals of good breeds for interbreeding stock."

owing analyses, made shortly after the established, will give some idea of the its soils at the time; the soils analysed of the best on the farm:—

ituents.	No. 4 Field (east side). Surface soil.	No. 4 Field (east side). Sub-soil.	No. 1 Field. Surface soil.
	Per cent.	Per cent.	Per cent.
....	4·420	2·060	3·240
n..........	1·800	2·900	1·350
f lime......	·240	·009	·120
f lime......	·700	·560	·310
magnesia .	trace	trace	trace
lime	do.	do.	do.
....	1·080	·720	·900
....	2·760	1·420	2·090
tter........	2·500	1·740	2·120
....	85·900	90·400	89·870
otal........	99·400	99·809	100·000

The farm, being without natural pasturage of any value, it became necessary, soon after it was opened, to undertake experiments in producing fodder for the valuable stock it possessed. Attention was first given to the crops which, in Europe, furnish green fodder; but it was soon ascertained that, with the exception of Lucerne, they were ill-adapted for culture in the hot plains of South India. Most of the plants grew fairly well in the cold season, but died off immediately the hot weather set in. Amongst these crops were *Lolium perenne*, *Lolium Italicum*, *Trifolium incarnatum*, Lucerne, vetches, millet, and a great variety of pasture grasses. Seeds of grasses and fodder crops were also obtained from the United States, Mexico, New South Wales, Queensland, China, Egypt, Italy, &c. The prairie grass and buffalo grass of the United States, were quite unable to stand the great heat of Madras. Several varieties of native grasses from Queensland have thriven as well as could be desired, but they are far inferior to European grasses.

Guinea grass (*Panicum jumentorum*) has been thoroughly established, and now affords the chief pasturage at the farm. The cultivation of Guinea grass has been wisely extended. The grass is much coarser than any European pasture grass. All kinds of stock eat it freely, and thrive on it. When it was first introduced at the farm, it was grown as an irrigated crop. But it was thought, that if the habits of the plant could be altered, it might become adapted for cultiva-tion on unirrigated land. Accordingly, several experiments were commenced with this view, the results of which have proved highly satisfactory. At the farm, at the present time, there are con-siderable areas of this crop, which, for at least three or four years, have depended entirely on the rainfall. This result has been obtained chiefly by inducing the plant to send its root deeper into the soil, and by gradually accustoming it to smaller and smaller applications of irrigation, water applied at gradually lengthening intervals, until finally discontinued. *Sorghum saccharatum* and *Sorghum Caffrorum*, imported from China, United States, and Australia have, through the farm, become thoroughly naturalised in Madras. When these valuable crops are more generally cultivated, there is every probability that the manufacture of Sorghum sugar will be largely engaged in. The experiments made at the farm show that both plants contain a large amount of sugar, that the saccharine juice is very easily extracted, and that the waste, after crushing, affords a very valuable cattle food. The Agricul-tural Department of Madras is using its best endeavours to extend the cultivation of these crops, chiefly in view to the provision of fodder for use in the hot dry season, when the natural pasturage is all burnt up. Crops of from 15,000 lbs. to 20,000 lbs. per acre of most excellent fodder have been raised on the poor soils of the farm, without the aid of irrigation, during growing periods, varying in length from eighty to one hundred and five days.

But by far the best results in growing fodder were obtained with the previously despised in-digenous cereal crops of the country. Amongst these I may mention *Sorghum vulgare*, *Penicil-laria spicata*, *Panicum Miliaceum*, *Panicum miliare*

Panicum Italicum, *Eleusine coracana*, and of the leguminous order, *Dolichos uniflorus*. Several of these crops, under very ordinary tillage, and without irrigation, have yielded crops of fodder of over 20,000 lbs. per acre, in periods of from seventy to one hundred days. With occasional irrigation *Sorghum vulgare* has, within twelve months, in several cuttings, yielded crops of fodder weighing upwards of 50,000 lbs. per acre, and in one experiment as much as 80,000 lbs. per acre was obtained, the plants standing generally over the ground about twelve feet high. The cost of producing fodder from these native plants is seldom higher than five shillings per ton, a price very considerably below its feeding value. The fodder is usually rich in saccharine matters, and very succulent and digestible.

Many experiments have been made with native grasses; the majority of them have been found to be very coarse, and almost worthless, excepting when very young. There is one grass, however, *Cynodon dactylon*, which gave very good results under high manuring and occasional irrigation. Further experiments are being made with native grasses, and with the grasses of other countries likely to thrive in South India. The discovery and extended cultivation of some really good grasses in South India would prove of immense advantage to the country.

Maize, introduced from America, Egypt, and North Australia, has thriven at the farm, and a large amount of seed has been distributed over South India.

Wheat of Northern India has been tried, but its cultivation has not yet proved a success, chiefly due to the great heat encountered at Madras. In some portions of the Presidency, at elevations of from 2,000 feet and upwards, wheat of fair quality may be produced, but, generally, the variety grown is inferior spelt variety.

Of fibre crops, many varieties have been introduced and cultivated at the farm. Of these, I may mention *Cannabis sativa*, *Corchorus capsularis*, *Crotalaria juncea*, *Linum usitatissimum*, *Bœhmeria nivea*, and cotton of various kinds.

When the farm was instituted, it was believed generally that cotton could not be grown successfully on such light soils as those constituting the farm. However, it has been shown most conclusively there, that abundant crops of very fair cotton can be produced at a profit; while, over the Presidency generally, on soils far superior to those of the farm, the yield of clean lint is only, on the average, about 60 lbs. per acre; the average outcome per acre on the farm is fully three times this weight, while the price obtained is as high as for any cotton produced in South India. The farm has grown extensively Egyptian, New Orleans, Upland, Lea island, Yea valley, and other varieties, the seed of which has been distributed to native cultivators, and others. Many other kinds of crops have been experimented with; crops obtained from tropical countries abroad; crops introduced from the other provinces of India; and crops of South India not generally cultivated, or badly cultivated, apparently deserving of attention. But I cannot occupy your time in referring more fully to these crops. Those who are interested in the matter, and who wish for further information, will find full details in the annual reports of the Madras Agricultural De[p]
and in the "Saidapet Farm Manual," th[e]
compilation from these reports.

During the last ten years, many fie[ld]
ments have been conducted at the fa
manures available in South India, but wh
recently, were almost unused in native hu
The results obtained with these manures h
widely published in the reports of the dep
and by other means. The experiments hav
that there is a great amount of valuable
now wasted which the ryot could, wit
advantage, apply to his starved soil.

Seeing that South Indian agricultu
dependent on irrigation water, the proper
tion of this water has occupied a good
attention on the farm. It has been show
that good crops of paddy can be produc
on sandy soils, with an expenditure o
less than one-half the quantity generally
native husbandry; results obtained ch
deeper tillage and the use of organic
Experiments extended to unirrigated la
shown that, with deep tillage and the
use of vegetable manures, these soils are
to take up large quantities of moisture
air during night, and to retain and shore
practically securing irrigation from the
this direction, a great deal could be
developing the drought resisting pow
large area of land in South India—a r
importance of which I need not occup
pointing out.

The heavy expense incurred by the r
his primitive arrangement for raising w
wells, early attracted the attention of th
ing authorities of the farm, and man
ments were instituted with pumps and v
of different kinds, driven by steam-pow
power, by cattle, and by manual labour
of the water-lifts, of the patterns mc
approved, have, for a long time, been
worked on the farm, thus affording na
vators interested in the matter every op
of judging for themselves the working c
of these machines. One of these w
which can be made up by almost an
carpenter, raises the water at less tha
cost at which it is raised by the primitive
ment generally used in South India.
proved water-lift has been constructed
places from drawings, or models, supp
the farm.

In my first paper (7th May, 1880)
very fully to the advantages the Europe
plough possessed over the ploughs emp
native cultivators. The Saidapet farm ha
12 years, been worked entirely by ploug
modern make. They are each drawn by a
sized pair of cattle, and driven by a sin
ploughman. Ploughs have been impo
England, Sweden, and the United States.
pony ploughs, made by Messrs. Howard
of Bedford, and Messrs. Ransomes, Sims a
of Ipswich, have proved great successe
of the ploughs now working on the Saida
and that have been regularly worked the
past 12 years, are still in a thorough
order; of course, they have been kept in
repair.

esults of the experiments made at Saidapet own conclusively that it is a great mistake ommend ryots to buy low-priced ploughs because they are low-priced. It is a far economy to pay £2 or £3 for a really well-iron plough, than to pay 10s. or 15s. for a -constructed plough, made of wood with working-parts, which is constantly needing —often when work is pressing—and seldom longer than two or three years. There are ly many ryots who do not possess the means with to buy a plough of the kind I recom- but there are tens of thousands who do. It be as ridiculous to state that steam ploughs be used in England, because each farmer the means to supply himself with such an lus, as to state that in India good ploughs modern shape cannot be introduced, because ts are too poor to buy these ploughs.

nprovement of live stock has occupied much n. There are no facilities at Saidapet for ning a large breeding herd of cattle, but a of bulls are kept there for improving the the neighbourhood. A breed of cattle, d from Aden, has been introduced with The breed is noted as a dairy breed. It that, by the use of bulls of this breed, the ducing capabilities of the cows of the in- s breeds may be considerably improved. mention that the average yield of milk of ary native cow is less than two quarts per u will understand what room there is rovement, an improvement which would nefit to the people generally, for nearly ld be consumers of milk, if they could t at a moderate price. Experiments made farm show that an average cow of Aden ill yield daily at least six quarts of good Experiments have also been made in deter- the milking capabilities, under good ment, of different native breeds, and of with European breeds. The housing and management of horned stock have also attention. How necessary this is, you derstand when I tell you that the cold hich accompanied the cyclone that broke ie neighbourhood of Saidapet in 1877, d, in the Revenue Division in which it is , 11,687 cattle, and 7,218 sheep, in a live umbering 30,000 head of cattle, and 16,000 On the farm, which was exposed to the ce of the cyclone, the loss was only three Shelter in India is almost as necessary for k as it is in England.

uld have liked to have described to you lly the actual work of the Madras Agri- l Department, but I have already trespassed n your time and attention I must forbear. orts before alluded to describe fully this nd such indications of progress in agri- l reform as have been ascertained. Looking er a period of twelve years engaged in this nterprise, though I cannot point out any bright examples of progress, I feel satisfied ich good has been done, chiefly in collecting d spreading information which, when the mes for energetic work in agricultural will bear fruit. Already, as I have pointed ricultural education, which would have impossible undertaking only a few years ago, is now beginning its beneficial influences in the country; influences which, I firmly believe, will do for Indian agriculture what could be attained by no other means.

MISCELLANEOUS.

FAURE'S SECONDARY BATTERY.

Since the publication of Sir William Thomson's letter to the Editor of the *Times*, on the electric storage of energy (printed in the *Journal* of June 10, p. 622), Professor Osborne Reynolds, F.R.S., of Owens College, Manchester, has written the following letter to the *Times*:—

"Although agreeing with every word of Sir William Thomson's letter in the *Times* of to-day, and entirely sympathising with his enthusiasm as regards the marvellous box of electricity, still I feel that it would have been desirable if, in pointing out the importance of this new discovery, Sir William Thomson had guarded against a very probable misconstruction of the purport of his letter.

"The means of storing and re-storing mechanical energy form the aspiration, not only of Sir William, but of every educated mechanic. It is, however, a question of degree—of the amount of energy stored as compared with the weight of the reservoir, the standard of comparison being coal and corn. Looked at in this way, one cannot but ask whether, if this form of storage is to be the realisation of our aspirations, it is not completely disappointing. Large numbers are apt to create a wrong impression, until we inquire what is the unit. Eleven million foot pounds of energy is what is stored in 1 lb. of ordinary coal. So that in this box, weighing 75 lb., there was just as much energy as in 1½ oz. of coal, which might have been brought from Paris or anywhere else in a waistcoat pocket, or have been sent by letter.

"When we come to the question of the actual conveyance of energy for mechanical purposes, this view is of fundamental importance. The weight of the same amount of energy in the new form is 800 times greater than the equivalent amount of coal; and as a matter of economy, supposing that energy in this form might be had at a certain spot, and no capital were required for its conversion or storage, and that the energy were directly applicable, it could not be carried ten miles—that is to say, such energy cannot be economically useful ten miles from its source, although coal had to be carried 100 miles to the spot. This limit, in truth, falls far short of what has been already obtained by other means. By wire ropes, and by compressed air or steam, energy may be economically transmitted from 10 to 20 miles. So that if this is the utmost of what is to be done by means of the storage of electricity, this discovery adds another door to those which are hopelessly closed against the possibility of finding in Niagara or other water power a substitute for our coal, even when the object is motive power, and much more for that purpose for which five-sixths of our coal is used—the production of heat.

"It is very important that the people of this country should not shut their eyes to the fact that, so far from there being a greater prospect of the solution of the problem than when, about 20 years ago, Professor Jevons raised the alarm, the prospect is now much smaller. In the meantime, the capabilities of steel ropes, fluids in pipes, and electricity along conductors have been not only investigated, but practically tested and

found altogether wanting. And now it would seem that the storage of electricity must be added to the list."

Another letter on the same subject, from Professor W. E. Ayrton, F.R.S., appeared in the *Times* on the next day, which is as follows:—

"Professor Osborne Reynolds's letter in your issue of Saturday, the 11th inst., shows that the first idea that has occurred to him on reading Sir William Thomson's letter on Faure's 'electric store' is, probably, what must have suggested itself to many engineers, viz., that so far from a million foot pounds being a surprisingly large amount of energy to be stored up in a mass of 75 lb., it is really extremely small; and, indeed, while crossing over from Paris at the commencement of last week, I could not help thinking that the passengers were bringing to England, literally in the smuts and blacks on their coats, far more energy than had ever been imported into this country stored up in Faure's secondary batteries. But although it is perfectly true, as Professor Reynolds says, that 1¼ oz. of coal contains about one million foot pounds of work stored up in it, this is by no means all that has to be taken into account in considering this question; for where is the engine for extracting this million foot pounds of work out of the 1¼ oz. of coal? Indeed, as Professor Reynolds would himself tell us, we cannot get much more than one-tenth of this amount of work out of the 1¼ oz. of coal, even in our largest steam-engines, which burn many pounds of coal per minute, and in which much heat has been wasted in getting up steam. And if we come to the burning of one single 1¼ oz. of coal, I know of no engine that can obtain from this even one thousand foot pounds of work, or one-thousandth of the energy contained in the coal, if no other coal be used in getting up steam or in previously heating the engine.

"But if a secondary battery be allowed to drive a magneto-electro-motor or a dynamo-electric machine with separate exciter, only even for the short time necessary to develop, say, 30 foot pounds of mechanical work, I anticipate this can be done without using up in the whole process more than about 35 foot pounds of the electric energy stored up in the reservoir, since the experiments of Professor Perry and myself have shown that, when the motor is running at high speeds with a light load, as much as 93 per cent. of the electric energy put into a magneto-electro-motor is given out again as mechanical work measured by an absorption dynamometer.

"It may be answered, however, that if a small bit of coal, although containing a vast store of energy, is not of much practical use in producing work, in consequence of the absence, up to the present time, of a proper converter of the coal's energy into mechanical work, at any rate a small galvanic battery (a little Daniell's cell, for example) is not only a vast storehouse of power, but contains a store which we have the means of converting, without appreciable loss, into electric light or mechanical work. How, then, is a Faure's box a better store of electric energy than a little Daniell's cell? This question has precisely the same answer as, "Why is a pinch of dry gunpowder better than a pinch of wet?" Not because the dry gunpowder has more energy in it than wet, but because the energy stored up in the dry gunpowder can be all, if we wish, used up quickly, and an explosion produced, whereas that in the wet can only be utilised bit by bit. So seven Faure's boxes will produce an illumination of 100 candles in Swan lamps for six hours, while seven Daniell's cells, or, indeed, twice that number, although possessing a store of power millions of times as great as that in the Faure's boxes, will not illuminate a single Swan light.

"But while fully recognising the great advance made in the subject by Planté, and the recent improvements introduced by Faure, I do not wish to give the impression that the problem is by any means solved, since, if the attempt that Mr. Perry no doubt like many other electricians, are convert at a low temperature the energy electric energy meets with even a fairly solution, then a fragment of coal, or, it ma of gas rich in carbon or carbonic oxide practical store of energy of incomparably g than any secondary battery."

Sir William Thomson, writing on th points out that the credit of first alluding as the natural and proper chief motor for t the North American Continent, is due to Siemens, F.R.S., and adds, "that, under realisable conditions of intensity, a copper an inch diameter would suffice to take 2 power from water wheels driven by th (losing only 20 per cent. on the way) to horse power at a distance of 300 British s the prime cost of the copper amounting t less than £3 per horse power actually y distant station."

In a letter of the 11th inst., Sir Will writes further:—

"It will be seen that I thoroughly sy Professor Osborne Reynolds in his aspir utilisation of Niagara as a motor, but tha Siemens nor I agree with him in the con he asserts in his letter to you, published of to-day, that electricity has been trie wanting as a means for attaining such transmission of power, however, was not my letter to you published in the *Times* of and Professor Reynolds's disappointment wi practical realisation of electric storage, b not provide a method of porterage superior through a wire, is like being disappoi invention of improvements in water-ca reservoirs, because the best that can be do of movable water-cans and fixed water r never let the water-carrier supersede water- ever water-pipes can be laid.

"The 1¼ oz. of coal cited by Prof Reynolds as containing a million of foot in it, is no analogy to the Faure accumula the same amount of energy. The accum re-charged with energy when it is exhau fresh store drawn upon when needed, more than 10 or 15 per cent. with arrang for practical purposes. If coal could b that is to say, if carbon could be extracted acid by any economic process of chemi action, as it is in nature by the growth of p on sunlight for the requisite energy—the r analogous to what is done in Faure's accu

[In Sir William Thomson's letter, p. 62 "its own" should read "my own."]

THE CULTIVATION OF WHEAT-S THE MANUFACTURE OF STRAW TUSCANY.

For centuries the manufacture of straw a special art in Tuscany, and Signa, one industrious of Tuscan towns, was for a l centre of the trade, which, however, was portance and limited until the seventeenth c it commenced to attract considerable a large quantities were manufactured both and for exportation. There are three vari of the golden plant (pianta della fi straw is called in Tuscany, the first is ca deras semone," which produces the best st the second, "Marzuolo," which is of a m quality; and the "Santa Fiore," which is pedals and braids. The Pontederas semo

...oil, while the other two varieties require a more ...e soil. Seed is sown in November and December, ...ding to the season, the object being to have the ...well up before the heavy frosts come, in the pro- ...n of eleven hectolitres to each hectare, that is, ...12¼ bushels to the acre. It is sown as ...y as possible, in order that the growth of the ...may be so impoverished as to produce a ...stalk, at the same time having towards the ...om the last knot the lightest and longest ... Side hills, with a gravelly soil, and high ... lands that have had a surface ploughing ...gh harrowing, are specially adapted to the ...lture, low swampy gronnds being generally ..., as dampness when the stalk is well grown the straw discoloured and coarse. The ground ...hed and dug up in June, and left in this ... until November, when the soil is again ...p, and then it is ready for sowing. If the soil is ...r and thin, a very light surface of manuring ...mally used, but this is not frequently resorted ... apt to render the stalk thin and brittle. The ...ooms at the end of May or beginning of June; ...rally pulled out by hand by the roots when ... is half developed. For uprooting the straw, ...nued sunny weather is selected, as the rain ...ry injurious effect upon it, often turning it ...When uprooted, the branches are tied together ...s, each sheaf, or "menata," is spread out in ...e of a fan to dry in the sun, from three ...ays after which it is stowed away in barns, ...est being over, and the fields being only in ...the straw is again spread out to catch the ...nmer dews, and to bleach in the sun for four ...ys, but not the whole of the crop at the same ...fear of a sudden rain. During this process it ...ly turned until all sides are equally white. ...the yellow colour of the straw was preferred, ...he extra white is more sought after. Before ...dy to be made up into braids, hats, and orna- ...e straw has to be again bleached, fastened in ...dles, and classified. It is then cut close above ...joint from the top, and again tied up in ...dles containing about sixty stalks in each. ...nall sheaves are then submerged in clear ...r four or five minutes, and as soon ...become partially dried, are submitted to the ...burnt sulphur (in the proportions of one pound ...undred bundles of straw) for three or four ... rooms adapted for the purpose; during the ...loors of these rooms are left open. The classifi- ... the straw is made according to length and ...e ear or end of the stalk having been previously ... all the straw below the first knot is used ...r forage or bedding, as it is worthless for the ... of making braids or hats. There are no ... says the United States Consul at Florence, for ...up straw, but in almost every private dwelling ...wer classes will be found one or more of the ...mates attending to her domestic duties, and at ... time making braids and sewing on hats. A ...le is found for their work at the nearest market, ...in many instances, special contracts are made ..."fattores" (straw brokers) with the work- ...directly, they supplying the straws into which ...ls are made up. Many women make from 28 ...ards of braids a day, and some can finish ...) yards of common braids, but fine braids ...very great care and cleanliness. Owing ...great strain upon the eyes, the finer kinds of ...an only be worked upon from two or three ...ch day; it takes, therefore, a woman from four ...ays to make braid sufficient for the hats usually ...men, while for the superior Leghorn hats for ...requires from five to nine months for each hat. ...oticeable fact that, in several districts where the ...s are made, the workwomen suffer greatly from affection of the eyes, caused by too close application to this kind of labour. Between 1822 and 1826, women employed in making braids realised from 6s. to 7s. a day, but at the present time the best braid-makers and hat-sewers only make about 1s. The most important centres of the straw industry are Brozzi, Signa, Prato, Ficsole, the Casentino, the Bolognese, and the Modenese. The province of Casentino is one of the most industrious in Tuscany, producing from 300,000 to 400,000 hats yearly, all for exportation. These hats, though hitherto comparatively unknown, are now very much sought after, on account of their strength and cheapness, prices varying from 4d. to 1s. each. In the Bolognese, the straw manufacture is confined chiefly to the mountain districts along the base of the Apennines, where the inhabitants of seventeen parishes are engaged in making the cheaper and coarser kinds. Laino and Searicalasino are the centre of this trade. Bolognese hats are brought to Florence to be fashioned, and the price paid is from 1s. 6d. to 2s. 6d. per dozen, and the quantity brought amounts to about 120,000 dozen yearly. For the last thirty years the annual exportation of straw goods from Tuscany averaged 12,000,000 lire, 5,000,000 lire alone being exported to the United States in 1878. By a comparison of the three principal products annually exported from Tuscany, straw goods show a value of 12,000,000 lire; silk, 5,000,000 lire, and timber, 4,000,000 lire.

UNITED STATES POST-OFFICE.

The United States Post-office Department has issued a statement of the results of an inquiry as to the amount and distribution of the postal business of the country during the year ending Dec. 31, 1880.

The whole number of letters posted was	1,053,252,876
" " " post-cards "	324,556,440
" " " newspapers "	812,032,000
" " " magazines and other periodicals	40,148,792
The whole number of packages of merchandise	21,515,832
Various	468,728,312
Total........	2,720,234,252

The number of letters posted average twenty-one for each man, woman, and child in the United States. This total is then analysed, and the relative numbers of each State given in a table. The two extremes are, Alaska, with its unlettered population, and the district of Columbia, the centre of the postal system, and the seat of National Government. In Alaska, only one inhabitant in five is credited with one letter a year, while in the district of Columbia there are 85 letters posted for each inhabitant. The most letters are written where there is proportionally the largest intelligent adult population who are away from home, namely, the newer States and Territories. Colorado heads the list of letter-writing communities, with fifty-five and a fraction to each inhabitant. The settlers in Arizona write 32 letters each a year, Dakota 30, Montana 40, Nevada 32, California 26, Idaho 25, and Wyoming 42. The States, which supply most of the letter-writers of the Territories, in addition to being the great seats of manufactures and commerce, come next, New York, with 42 letters to each inhabitant, Massachusetts with 39, Connecticut with 38. The people of the South are not letter-writers generally, nor are they as much given to migration as the people of the north. The result is that the contributions of the Southern States to the mail bags are extremely small. The annual average for each inhabitant of Alabama is 7, Arkansas 8, Georgia 9, Kentucky 9, Mississippi 6, North Carolina 6, South Carolina 7, Tennessee 7, West Virginia 8. The figures for other Southern states are, it will be seen, somewhat

higher:—Florida 11, Virginia 11, Texas 12, Louisiana 15, New Mexico 13. The more Northern States which write the fewest letters are Delaware 16, Indiana 13, Wisconsin 17, Washington Territory 15.

CINCHONA IN THE UNITED STATES.

Consul General Adams, of La Paz, Bolivia, states that he has no doubt but that the cinchona may be cultivated in some parts of the United States, where the soil and climate are favourable to its culture. After a full investigation into the cultivation of the *Cinchona calisaya* in Bolivia, he gives the following information to those wishing to make the experiment of growing the tree in the United States, which is taken from the *Oil and Drug News*:—"The seed is sown broadcast upon a hot-bed, such as gardeners prepare in the spring for their early vegetables. The manure of the llama, for which, in the United States, sheep manure might be substituted, is freely mixed with the surface soil of the hot-bed, and, as the seed is very high, it should be slightly raked under, and the surface kept moist. As soon as the sprouts appear a shade should be constructed over the bed covered simply with leaves, straw or branches of trees, which, while it protects the tender plants from the hot sun, may allow the rain to penetrate and fall gently upon them, and it is advisable to locate such hot-beds on a hill-side, so that the water may quickly run off, continuous and limited moisture being required, rather than quantities of water and heavy falls of rain. As soon as the plant has grown to a height of from six to eight inches, it is ready for transplanting. The ground chosen for a quina plantation should also be sloping, if possible on the south side of hill or mountain, as experience has shown here that those located on level land do not prosper, and steep mountain sides are here preferred. The plants are set at regular intervals eight feet apart, and it is only necessary, if not better, to prepare the soil within a foot of where each plant is placed, as I am assured that by ploughing the whole field too much moisture would be retained in the soil. The plants are then slightly covered with fallen leaves or other rubbish to protect them from the hot sun a while longer, until they show a strong and healthy growth, after which all further care seems to be unnecessary, in Bolivia at least, where even the weeds are but superficially removed. A damp, warm climate, with heavy dews at night, and cloudy sky during the days, rather than a hot, burning sun—such as may be found in the mountainous regions of some of the Southern States, like Alabama and Georgia, where mists and threatening clouds hang over the mountains in summer and still no severe frosts occur in winter—this seems to be what is required for the cultivation of this plant: and I should not be surprised if the experiment should, under such conditions, prove successful, a result which would, undoubtedly, add greatly to the wealth and prosperity of the South. Bolivia being in the southern hemisphere, the seasons for sowing and transplanting in the United States will have to be changed; the former, instead of October here, should be done in April, and the latter in July, instead of January here. From these intervals it will be seen that the seeds require a long period to germinate and attain their first growth, but from all accounts, if the above directions are followed, and a little patience shown in the beginning, very little, if any, cultivation and trouble is necessary after the plant is transplanted and becomes firmly rooted and shows a healthy growth. In from five to six years the tree grows to a height of about 10 feet, and 5 to 6 inches in diameter, and at that age the bark contains the greatest per-centage of quinine, and is worth in Bolivia from 180 dollars to 200 dollars per quintal of 100 pounds. When the tree has attained this size and age, it is cut down close to the roots, the bark stripped entirely from the trunk and branches, and on shoots from the root is allowed to grow into In India, I am told, the custom prevails tc half of the tree, and allow this to grow agai other half is taken off; but by this pro assured, the per-centage of the sulphate cont second growth is much smaller than that ga method practised here. The seed which I mitted I have procured from one of the best and is warranted to be of the calisaya speci of the cinchonas. Lately, since the cultiva tree has assumed such large proportions this seed has become an article of local co that, should the experiments in the United successful, there would seem to be no c obtaining the necessary seed in larger quant

NOTES ON AMERICAN SCIENCE MECHANISM.

Increase of Immigration.

At no time in the history of New Yo statistics of immigration furnished such figures as at present. During the week 28, the arrivals of immigrants were 20,17 Saturday of that week alone, the ar 4,524, those of the day following be Since the beginning of the present year, arrived, up to May 29, inclusive, no fewer th which, when the returns of the 30th ar added, and which will presumably be 8,000 an accurate idea of the influx of immig America through one port alone. The re month of May alone exceeds the total num year 1878. The emigrants are despatch Western States after a very brief stay in

An Emigration Inspection Bil

The Assembly has passed the Emigrati imposes a tax of a dollar a head on al entering the country by the port of New collected from the steam-ship companie them, and devoted to defraying the expendi the Commissioners of Emigration. Emi also to be inspected, so as to prevent forei from exporting cripples, idiots, or other people.

American Claims for the Invention Locomotive.

In connection with the centennial of t George Stephenson, certain Americans ar against his being designated the "invent locomotive. This honour they claim for O of Philadelphia, who, it is alleged, was the ceive the idea of a high-pressure engine, fo obtained a patent in 1786-7. Five years be went to Albany in the "Clermont," and years before Stephenson built the "Rock had in use a high-pressure engine, which motive and steam-boat in itself, as it wa steam over the highway about a mile and a Schuylkill river, thence paddling its way wheel to Philadelphia. The construction of which was named "Eructor Amphibolis," Americans conceived to warrant the title of the locomotive being associated with t Evans rather than that of Stephenson, w genius they quite admit, although only as a rather than a first inventor.

[Evans's carriage, like all the early locom a common road carriage. He is stated to h it in 1772. He was before Symington Murdock (1786), but later than Cugnot, w steam-carriage in France in 1769. None of inventors can really claim to be the inve locomotive. Trevithick made a true locomot

in on rails, as well as a steam-carriage; the orked for some time on a circular tram near the ite of Euston-square in 1808. It was Stephen-rit to have rendered the locomotive a practical This is the credit which his true friends claim and this will not be lessened by any of the ess successful efforts of earlier inventors. No any knowledge of the early history of the gine would assign the merit of inventing the re to George Stephenson.—Ed. *S. of A. Jl.*]

reasing the Rapidity of Locomotives.

nerican mechanic, Mr. Fontaine, is seeking to the rapidity of the locomotive by the applica-ne principle that a small wheel, when driven e one, makes more revolutions than the motor With him it has not remained a mere con-for it has passed into the experimental stage—e having been constructed on this principle. ine drew a train full of high officials over the Southern Railway, from Amherstbury to St. a distance of 111 miles, in 98 minutes. That trip was considered satisfactory, is evident fact that the officials have given orders for ngines to be constructed on the same model.

"Holland Hydrogen Process" Applied to the Steam-engine.

nother improvement upon the steam-engine, having reference to the method of heating the This is not effected by coke or coals as hereto-by hydrogen gas, which is generated as it is d. The principle of forming gas by the union heated steam with an hydro-carbon has long wn, but by the method adopted by Dr. Charles of Chicago, and hence named the Holland process, it is stated that a greater degree of as resulted than by any other. This system of was applied to locomotives more than a year it is only now that it has been improved in legree as to challenge public attention. By brief account of an engine on the Flatbush and sland Railroad, some idea will be had of the f the heating apparatus. The fire-chamber or (eight feet by three) is floored with iron plates, are screwed 352 burners, which project upwards wo inches, each being enclosed by an open which acts like a lamp chimney to its flame. In mber are also four strong iron retorts, which ected by iron pipes with the water tank of the an oil tank on the tender, and the steam space boiler. When sufficiently heated, the retorts er-heated steam and petroleum vapour together 52 burners, a certain number of which are under rts, and sustain their heat. From a carefully ial, the statistics of which have been furnished, ars that it took seventy minutes to raise the p to ten pounds pressure, five and a-half gallons aving been used in doing so. In fifteen minutes is pressure was doubled, at an expenditure of d three-quarter gallons. After this the pressure d with great rapidity and at a greatly decreased iture of the oil, which is a very cheap product rica. When the pressure reached about seventy , it only required four minutes to raise it each nds over this until it reached 120 pounds, the ended on each of these ten pounds being one The total time from lighting to the obtaining maximum pressure here mentioned (and after g which the engine was despatched on its r) was two and a-half hours, twenty-six gallons aving been used. This oil, or naphtha, I have very cheap, the whole cost of the twenty-six being here only 78 cents., or 3s. 1½d. English When coal is employed to effect the same a ton and a-half is said to be required, costing rs. It is considered that, at a cost of 36 cents. l.) per hour, a fast train may be run. The appearance of the flame is similar to that of pure hydrogen, that is, scarcely visible, although possessing great heating properties.

New York, June 1, 1881. J. T. T.

SWAN ELECTRIC LAMP AT PLEASLEY COLLIERY.

The Royal Commissioners upon Accidents in Mines, including Professor Abel, Mr. Warington Smyth, Professor Tyndall, and others, made an examination last week of the experiments on the application of electric lighting to coal mines, which are being carried out at the Pleasley Colliery, near Mansfield. The pits are about 1,600 ft. deep, and the workings are very extensive, but in the present instance the light was applied to three workings only, situated at a distance of about one-third of a mile from the bottom of the pits. The Swan system was adopted, and the arrangements were carried out by Messrs. R. E. Crompton and Co. The lamps themselves were enclosed in lanterns of a very ingenious construction, designed and made by Messrs. Crompton, which enabled the very fragile glass bulbs to be carried about without fear of accident, and at the same time rendered it impossible that the fracture of the lamp within could cause an explosion, inasmuch as the air inside the lantern would suffice for the instantaneous combustion of the carbon filaments before the flame could be communicated to the external air. In working the coal, the men undercut the face to the depth of some five or six feet, and the superincumbent mass is then brought down by wedges or blasting. It is said that the new lamp was found to be admirably suited for the requirements of the workers, since it not only gave a light many times as intense as the lights it replaced, but it was equally brilliant in whatever position it was placed, and it required absolutely no attention. In addition to the lamps which were used in the actual workings of the pit, the pit bottom was lighted up with similar lamps. The number of lights employed was 94 in all, which were worked by the current of an ordinary Gramme machine driven by a portable engine placed near the top of the upcast shaft.

CORRESPONDENCE.

MANUFACTURES, TRADE, AND PROGRESS OF ENGLAND.

The important and opportune contribution of Mr. Hyde Clarke, in our last *Journal*, is of such vital importance to the glory, wealth, and progress of this country, and the working classes in particular, that I venture to supplement his statement by some facts that are within my own knowledge, that confirm fully the truth and wisdom of his remarks, which I consider should be received by all leaders of opinion as a warning that the time has arrived when some action should be taken to demand of the Government the appointment of a Minister to look after our commerce, both home, colonial, and foreign, and to prevent in time the ruin that the one-sided free trade, regulated as it is against our countrymen in every trade and calling, is fast bringing about.

I will confine this letter to the following fact. Within the last few weeks it has come to my knowledge that one of our oldest established and well-known West India merchants' house in London has, with a view to counteract the impending ruin caused by foreign Government sugar bounties, opened a house of business in New York, that a few months has satisfied them and their British West Indian friends that it is much more profitable to send their sugars to that foreign country than to the old country. The experi-

ment is so successful, that they are about opening branch houses at Philadelphia, Boston, and Halifax.

The last West Indian mail brought me a letter from an old friend of forty years standing, in which he remarks:—"I consider West Indians are in a much better position than in my recollection, now that we have regular communication with, and sales in, America."

It was only recently that the *Times*, in supporting its well-known free trade views, admitted that our exports were falling off; that our imports paid for in money were enormously increasing; that our foreign trade in exports was diminishing, except in machinery (machinery to make goods to meet us in every market); and that we should do well to cultivate closer intimacy with our own colonies.

I have reason to believe that half the exports from the West Indies this year will be sent to the United States, and I am of opinion that in a very few years these once magnificent possessions of the English Crown will have peaceably passed away from us, to the serious loss of our working classes; for they may depend upon it that those who receive the sugar will manufacture the machinery to make more, construct the carts to carry it, supply all the numerous requisites required in this costly manufacture, clothe the ladies, educate and Americanise their children. And I am able to state that already the loss to us at home is very considerable, caused by our ships being disused, and those sailing under the stars and stripes being alone used in carrying in each direction the industry of the two countries, while old England allows her ships to rot in dock, and her once industrious population to be left out in the cold.

Depend upon it there is too much energy and good sense left in us yet, for this state of things to continue much longer, and the cry from the working classes will be, Protection to native industry.

HENRY LIGGINS.

3, Ladbroke-square, W.,
13th June, 1881.

NOTES ON BOOKS.

Legendary History of the Maoris. New Zealand, 1880. Folio.

This paper consists of a series of extracts from a compilation of the "Legendary History of the Maoris" which has lately been presented to both Houses of the General Assembly of New Zealand, and printed. From the memorandum, by Mr. John White, it appears that the different canoes that came to these islands were distinct migrations of the same people, all coming originally from one distant home; having parted in the Pacific Ocean, they had rested for a time, some in one group and some in another of the different clusters of islands. "These various migrations; or parts of a great migration, had evidently met and become partially amalgamated with other branches of a race previously located in those islands. By this contact the Maori had learned words of another language, and had modified and altered his mythology, thereby giving rise to the difference apparent at the reunion of the Maori people in New Zealand." Mr. White found names in a genealogy of the Kings of Hawaiki, or Sandwich Islands, printed in 1838, which are identical with those of chiefs given in the genealogy of the New Zealand, Takituma, and Arawa migration. In compiling this history of the Maoris, it is proposed "to give the oral traditions consecutively, placing those first which relate to actions most remote, giving, as far as practicable, in notes such of the parallel traditions which other Polynesians have preserved as may appear only relating to the same circumstances as those given in the Maori traditions, thus affording to those who may wish to continue the subject a starting-point for further research."

THE LIBRARY.

The following works have been present[...] Library:—

The Fields of Great Britain. A Text-boo[k ...] culture. By Hugh Clements. (London[...] Lockwood, and Co., 1881.) Presented by th[e ...]

Horticultural Buildings. By F. A. Fawkes. [...] B. T. Batsford.) Presented by the Author.

Catalogue of the Library of the Institute of [...] (London: Institute of Actuaries, Nov., 1880.) [...] by the Institute.

Aristology, or the Art of Dining. By Thom[...] M.A. With Preface and Notes by Felix [...] (London: George Bell and Sons, 1881.) P[...] Sir Henry Cole, K.C.B.

Chapters on the History of Old St. Paul[...] Sparrow Simpson, D.D., F.S.A. (Lond[...] Stock, 1881.) Presented by the Publisher.

MEETINGS FOR THE ENSUING W[EEK].

MONDAY, JUNE 20TH...Domestic Economy Congress [...] Albert Hall, S.W.), 8 p.m. *Conversazion[e ...]* Promenade.
Asiatic, 22, Albemarle-street, W., 3 p.m.

TUESDAY, JUNE 21ST...Domestic Economy Congress [...] OF THE SOCIETY OF ARTS), 11 a.m. Rea[...] and Discussions.
Statistical, Somerset-house-terrace, Strand, [...] Mr. Hyde Clarke, "The English Statio[...] Regions of India; their Value and Imp[...] some Statistics of their Products and Tra[...]
Zoological, 11, Hanover-square, W., 8½ p.m.

WEDNESDAY, JUNE 22ND...Domestic Economy Co[...] Royal Albert Hall), 11 a.m. Evening M[...] HOUSE OF THE SOCIETY OF ARTS), 7 p.m.
Geological, Burlington-house, W., 8 p.m. [...] Tomes, "Description of a New Species [...] the Middle Lias of Oxfordshire." 2. Pr[...] "Note on the Occurrence of the Remain[s ...] in the Lower Oligocene Strata of the Ham[...] With a Note by Prof. H. G. Seeley. [...] Hollingworth, "Description of a Peat-be[d ...] fied with the Boulder-drift at Oldham." [...] Vine, "Silurian Uniserial *Stomatopora* [...] *ones*." 5. Mr. E. J. Dunn, "Notes on [...] Fields, South Africa." 6. Mr. P. H. [...] New *Comatula* from the Kelloway R[...] Sydney S. Buckman, "Descriptive Catal[ogue ...] nites from the Sherborne District."
Royal Society of Literature, 4, St. Martin[...] 8 p.m. Mr. C. F. Keary, "The Genuine a[nd ...] in the Eddaic Mythology." Part II.
Sanitary Institute of Great Britain, 9, Cond[...] 8 p.m. Prof. W. H. Corfield, "The P[...] the Sewage Question."
Royal Botanic, Inner-circle, Regent's-park [...] Evening Fête and Floral Exhibition.

THURSDAY, JUNE 23RD...Domestic Economy Co[...] Royal Albert Hall), 11 a.m. Reading [...] Discussions. 4 p.m., Lecture by Mrs. B[...]
Antiquaries, Burlington-house, W., 8½ p.m.
Society for the Encouragement of Fine Ar[ts ...] street, W., 8 p.m. Third *Conversazione.*
Royal Society Club, Willis's-rooms, St. J[...] 6½ p.m. Annual Meeting.

FRIDAY, JUNE 24TH...Domestic Economy Congress [...] OF THE SOCIETY OF ARTS), 11 a.m. and 7 p[...] Meeting.)
Royal United Service Institution, Whiteha[ll ...] Captain J. R. Lumley, "The Promotion [...] the Prussian Service, their Training, and [...] which their Efficiency and Capability a[re ...] Tested."
Philological, University College, W.C., 8 [...] Marshall, jun., "Aryan Roots, and th[e ...] Semitic and Hamatic."
Quekett Microscopical Club, University [...] 8 p.m. Mr. B. W. Priest, "A New Spec[...] from Honduras."

SATURDAY, JUNE 25TH...Domestic Economy Con[...] HOUSE OF THE SOCIETY OF ARTS), 11 a.m. [...]
Physical, Science Schools, South Kensingto[n ...] 1. Mr. W. Grant, "Apparatus for L[...] ments on Current Induction." 2. [...] Stewart and Mr. W. Stroud, "Results o[f ...] with a Modification of Bunsen's Calorim[eter ...]
Royal Botanic, Inner-circle, Regent's-park,

OF THE SOCIETY OF ARTS.

No. 1,492. Vol. XXIX.

:IDAY, JUNE 24, 1881.

ıs for the Society should be addressed to the Secretary
'ohn-street, Adelphi, London, W.C.

NOTICES.

FINANCIAL STATEMENT.

The following statement is published in this week's *Journal*, in accordance with sec. 40 of the Society's Bye-laws:—

JRERS' STATEMENT OF RECEIPTS, PAYMENTS, AND EXPENDITURE, FOR THE YEAR ENDING MAY 31st, 1881.

	£ s. d.	£ s. d.
ırs. Coutts and Co., 31st		
....	441 15 11	
ı of Secretary..............	4 15 7	
		446 11 6
received during the year		
bers and Institutions in		
....	6,005 10 0	
tions	609 0 0	
		6,614 10 0
l Interest.....................................		647 8 11
ı : — Prince Consort's		
I. the Queen)	26 5 0	
. ...	71 6 0	
		97 11 0
ce (receipts for gas, &c.)..................		34 0 0
ıts		1,457 13 4
chings	13 10 0	
ctures.........................	26 19 6	
Economy Reports	1 13 9	
....	134 6 7	
lucation Reports	3 9	
alth Conference Reports	8 13 10	
st-cards......................	1 3 10	
ns	1 2 6	
		187 13 9
		£9,485 8 6

Cr.

	£ s. d.	£ s. d.
By House and Premises:—		
Rent, Rates, and Taxes	342 15 0	
Insurance, Gas, Coal, House charges, and charges incidental to ordinary meetings..................	272 9 3	
Repairs and Alterations (including new drains £247, and lavatory £91)	459 19 6	
		1,075 3 9
„ Office:—		
Salaries and Wages	1,838 1 11	
Stationery, Office Printing, and Lithography	288 8 8	
Advertising................................	100 15 1	
Postage Stamps, Messengers' Fares, and Parcels....................	209 6 5	
		2,436 7 1
„ Cleaning Barry's Paintings..............................		37 0 0
„ Library, Bookbinding, &c.		108 13 2
„ Conversazione		234 4 9
„ *Journal*, including Printing, Stamps, and Distribution		2,016 12 2
„ Advertisements (Agents and Printing)		544 2 0
„ Union of Institutions, including Examinations, Prizes, Fees, Postage, Printing, &c.	433 12 6	
Prince Consort's Prize..................	26 5 0	
		459 17 6
„ Conference on Public Health, 1880		105 10 10
„ „ Domestic Economy, 1881..............		73 8 10
„ Medals:—		
Albert (1879 & 1880).....................	42 4 6	
Society's (see also "Committees")	22 3 6	
		64 8 0
„ Prizes:—		
Owen Jones................................	10 5 0	
Sanitation of Houses	3 11 0	
		13 16 0
„ Cantor Lectures		208 8 6
„ Juvenile Lectures		21 9 0
„ Sections:—		
Applied Chemistry and Physics......	74 11 0	
Foreign and Colonial	60 16 0	
Indian	51 0 0	
Sanitary	23 9 0	
		209 16 0
„ National Training School for Music......................		164 9 6
„ Committees:—		
Food	2 19 3	
Memorial Tablets........................	21 12 6	
Musical Education	14 9 8	
Patents	16 17 8	
Plant Labels	17 0	
Poisonous Colours.......................	5 14 0	
Protection of Ships from Fire (including Medal)	21 16 6	
General charges..........................	15 2 8	
		99 9 3
„ Art Workmanship Exhibition		5 7 3
„ Copyright (grant to Law Amendment Society)......		10 10 0
„ Annuity to Mrs. Cantor	25 0 0	
„ „ „ Mrs. Le Neve Foster	100 0 0	
		125 0 0
„ Investment of Life Compositions (£609) and balance due to Endowment Fund (£93 9s. 9d.) in purchase of £709 12s. 10d. reduced 3 per cent. stock		702 9 9
		8,716 3 4
„ Cash at Messrs. Coutts and Co., 31st May, 1881..................................	753 2 5	
„ Ditto in hands of Secretary	16 2 9	
		769 5 2
		£9,485 8 6

LIABILITIES.

	£	s.	d.	£	s.	d.
To Tradesmen's Bills	491	6	8			
„ Rates	43	15	0			
„ Examiners' Fees	54	12	0			
„ Examination Prizes	43	0	0			
„ Sir Walter Trevelyan's Prize	100	0	0			
„ Sections:—Colonial, Chemical, and Indian	170	0	0			
				903	13	8
Excess of Assets over Liabilities				8,617	6	10
				£9,520	0	6

ASSETS.

	£	s.	d.	£	s.
By Society's Funds invested in— Reduced 3 per Cent. Stock, £4,754 7s. 7d., worth on 31st May, £4,778 8s. 10d., less £665 2s. 3d., reserved to meet Trusts stated below	4,113	6	7		
£217 Great Indian Peninsula Railway 4 per Cent. Debenture Stock, worth on 31st May	231	2	0		
				4,34	
„ Subscriptions of the year uncollected	749	14	0		
„ Arrears, estimated as recoverable	300	0	0		
				1,04	
„ Property of the Society, including Barry's Pictures and Lease				2,00	
„ Advertisements on the Books due and in course of execution*				1,2	
„ Cash at Messrs. Coutts and Co., 31st May	753	2	5		
„ Ditto on Deposit	100	0	0		
„ Ditto in hands of Secretary (Petty Cash)	16	2	9		
				£9,	

* A portion of this sum is liable to charges for printing.

STOCKS AND CASH STANDING IN THE NAME OF THE SOCIETY.

	£	s.	d.
Consols	£4,891	6	4
New 3 per Cents	388	1	4
Reduced 3 per Cents	4,754	7	7
United States 5 per Cent. Funded Bonds, 1871 (2,500 dollars)	509	1	3
Oude and Rohilcund Railway 5 per Cent. Guaranteed Stock	2,150	0	0
Bombay and Baroda do. do.	2,450	0	0
Canada 4 per Cents	423	0	0
India 4 per Cents	105	18	7
Great Indian Peninsula Railway 4 per Cent. Guaranteed Debenture Stock	2,170	0	0
Metropolitan 3½ per Cent. Stock	343	14	3
Cash on deposit at Messrs. Coutts and Co.	100	0	0

TRUST FUNDS INCLUDED IN THE ABOVE.

	£	s.	d.	
1. Dr. Swiney's Bequest	£4,500	0	0	Consols, chargeable with a sum of £200 once in five ye
2. John Stock's Trust	100	0	0	„ „ the Award of a Medal.
3. Benjamin Shaw's Trust for Industrial Hygiène Prize	133	6	8	„ „ „ Interest as a M
4. North London Exhibition Trust	157	19	8	„ „ „
5. Fothergill's Trust	388	1	4	New 3 per Cents, chargeable with the Award of a Me
6. J. Murray, in aid of a Building Fund	50	0	0	Invested in Reduced 3 per Cent. Stock.
7. Subscriptions to an Endowment Fund	525	2	3	
8. Dr. Aldred's Bequest	90	0	0	
9. Thomas Howard's Bequest	500	0	0	„ „ United States 5 per Cent. Funded Bonds,
10. Dr. Cantor's Bequest	5,052	19	8	„ „ Bombay and Baroda and Oude and Guaranteed Railway Stock.
11. Owen Jones Memorial Trust	400	0	0	„ „ Canada 4 per Cent. Stock, charged with t Prizes to Art Students.
12. Mulready Trust	109	12	9	„ „ India 4 per Cent. Stock, the Interest to to keeping Monument in repair and Prizes to Art Students.
13. Alfred Davis's Bequest	1,800	0	0	„ „ Great Indian Peninsula 4 per Cent. Guar way Debenture Stock.
14. Memorial Window Fund	345	0	0	„ „ Metropolitan 3½ per Cent. Stock.
15. Sir Walter Trevelyan's Prize	100	0	0	On Deposit with Messrs. Coutts and Co,

The Receipts of the Society set forth above have been credited by Messrs. Coutts and Co.
The Payments set forth above have been made by authority of the Council.
The Assets, represented by Stock at the Bank of England, and securities, cash on deposit, and cash balance Coutts, as above set forth, have been duly verified.

B. FRANCIS COBB, } *Treasurers.*
OWEN ROBERTS, }
J. OLDFIELD CHADWICK, F.C.A., *A*
H. TRUEMAN WOOD, *Secretary.*

Society's House, Adelphi, 17th June, 1881.

ANNUAL GENERAL MEETING.

The Council hereby give notice that the One-Hundred and Twenty-seventh Annual General Meeting, for the purpose of receiving the Council's Report and the Treasurer's statement of receipts, payments, and expenditure during the past year, and also for the election of officers and new *Members*, will be held, in accordance with the Bye-laws, on Wednesday, the 29th of J o'clock p.m.

The Council think it well to call th attention of Members to the above notic express their hope that Members may fin venient to attend, and receive the repo Council on the work of the Session.

(By Order of the Council)
H. TRUEMAN WOOD, Sec

ART FURNITURE EXHIBITION.

he Exhibition of Works of Art Applied to niture, in connection with the Exhibition of e Arts at the Royal Albert Hall, is now open y. A non-transferable season ticket will be to any member of the Society on application he Secretary.

ROCEEDINGS OF THE SOCIETY.

DOMESTIC ECONOMY CONGRESS.

e Congress was opened on Monday evening, inst., with a *conversazione* and musical enade in the Royal Albert Hall and Con-tory of the Royal Horticultural Society. was a display of flowers in the Conservatory e Royal Horticultural Society, which, with djoining arcades, were illuminated by the ring systems of electric lighting:—Siemens , by Messrs. Siemens; the Maxim incan-t light, by the Electric Light and Power ator Company; and the Crompton light, by R. E. Crompton. An instrumental concert given by the band of the Royal Military m, in the Royal Horticultural Society's rvatory, and by the band of the Cold-n Guards, in the Royal Albert Hall. There also a selection of vocal and instrumental , by the scholars of the National Training l for Music, under the direction of Dr. Stainer; ction of part-songs, by the students of St. 's Training College, conducted by Mr. Owen n, and by children taught on the Tonic Sol-ethod, conducted by Mr. John Evans, In-or of Singing to the Board School of on. The exhibition of school needlework by ren in public elementary and other schools ome and abroad, was on view in the East tre of the Royal Albert Hall.

e meetings for the reading of papers and ssion commenced with the meeting of Section Methods of Teaching and Examining in estic Economy, in the Great Room of the ty on Tuesday, June 21st, 1881, the TESS OF AIRLIE in the chair, with Sir RY COLE, K.C.B., as assessor.

e first paper read was by **Lady Stuart Hogg**, on Teaching and Superintendence by Women in entary Schools."

ly Stuart Hogg wished to add that, when abroad, she ften noticed how very helpless our countrywomen The husbands of the women, to whose ignorance estic matters reference was made in the paper, were nly getting far better wages than many mechanics ilway clerks in England, and yet they were unable re any money, from having to maintain so many servants. With regard to soldiers' wives, they were absolutely dependent on the ladies to cut out their things for them. She therefore thought that this movement would be of enormous value in making Englishwomen really as useful as the corresponding classes in both France and Germany.

The Rev. J. P. Faunthorpe, before reading the next paper, begged leave to state that he had recently heard that the inspectors of needlework in France were exclusively women.

Paper read was, "Suggested Outlines of a Plan for Establishing Women's Inspection of the Teaching of Domestic Economy by Counties," proposed by some members of the Executive Committee of the Congress (Sir Henry Cole, Rev. Newton Price, and Rev. J. P. Faunthorpe).

Mr. Mostyn Price (one of her Majesty's Inspectors of Schools for Monmouthshire) said all inspectors of schools would cordially agree with what had been said by Lady Stuart Hogg as to the desirability of inspection of needlework by ladies. He would, however, not wish to hamper them with so exhausting a work as a progress throughout the counties, and would suggest that some system should be organised rather for enabling the inspection to be carried out at head-quarters. It might not be out of place altogether that, as a Government Inspector of Schools, he should offer a few remarks on the progress of teaching domestic economy in his district for the criticism of ladies present. Being a Government officer, acting under the direction of the Education Department, he must not be supposed for a moment to be officially criticising any part of the syllabus of the Code sanctioned by his superiors. And any remarks he might make, therefore, must be taken simply as offered in his private character of listener at this Congress. Mr. Price then gave an account of the need, in his Monmouthshire district, for such instruction as was proposed in the papers read, and of the work being done there.

Paper on "County Organisations for Teaching Branches of Domestic Economy," was read by the **Rev. Newton Price, M.A.**

Mr. Stephen Mitchell said that the method of teaching by books was at fault. Papers were sent in to the Science and Art Department in great numbers, but, though without any outward distinctions, they could be traced to particular schools by internal evidence, from containing the same mistakes and the same kind of blunders, showing that the children did not know what they were writing about, but that they were simply copying from text-books, without any knowledge of method or principle. He, therefore, deprecated the use of books for the children, though they would be useful for teachers; and the children should be shown how they could do things for themselves. With regard to the remark that while some ladies were able to work successfully, others rashly following them only exposed themselves to ridicule, that result simply arose from the ladies not knowing what they were teaching.

Mr. Kempson said it was very satisfactory that girls were being taught domestic economy in the schools, and with good results, but he also thought boys should be taught social and political economy as kindred subjects.

Mrs. Gover advocated the claims of factory girls to instruction of this kind. Thousands of them would as readily attend classes for their benefit as they would go to penny readings. Evening classes might usefully be established, as the Factory Acts compelled a cessation of labour at eight o'clock.

Miss Kenrick thought a divided inspectorship would not be so satisfactory as the present system. It was a mistake to suppose every woman knew something about sewing; and some who undertook that important branch of instruction were anything but competent to do so,

The instruction of very young children should be left to women; but it was a very different thing to say that they should be entrusted with all examinations, though ladies might properly be appointed to assist the inspectors in the examination of needlework, and such matters with which a man could not be so well acquainted. Confusion only would result from the appointment of two sets of inspectors, and an over amount of work would be extracted from the children. Cookery was not a subject which could be examined on, or made a means of obtaining a Government grant, but should rather be taught so as to be brought into the children's homes. Principles should be instilled into their minds by the help of experiments; and the girls' homes would then benefit by their teaching. Half the battle would be won, when once the children's minds were interested.

Sir Henry Cole agreed that very young children were better taught by women than by men. The two formidable words, "domestic economy," simply meant "home life," the knowledge of which should be inculcated (as it did, in fact, begin from the earliest age at home) before reading, writing, and arithmetic were taught; cleanliness was not a matter for text-books or physiological diagrams.

Miss Guthrie Wright said this Congress had particularly to do with the subject of teaching domestic economy in public elementary schools. Such instruction was as necessary for the higher as for the working classes, and if good examples were shown by the upper and middle classes, the subject would be much more popular and acceptable to the working classes, than if pushed among the latter exclusively. At the school in Edinburgh, the object arrived at was to teach subjects which could be made useful at home. That, of course, presented a very wide field for future work, and included sanitary teaching alike for rich and poor. The recognition of elementary teaching in the Code was only a matter of time; but in private schools considerable attention had been given to it, and the managers had been induced to take it up. Public attention in this direction was much required. More than was really possible to teach, in the shape of languages, drawing, and music, was expected from girls before leaving school, and it would be well if domestic economy were made, to a considerable extent, a substitute. Three subjects might be practically taught, cookery, laundry work, and cutting out clothes. A great deal of good had been done by the public cookery classes for older persons, and homely teaching could also be given at mothers' meetings, care being taken to leave out all technical expressions on the scientific part of the question.

Dr. Mann said that this Congress would be specially valuable if it should succeed in bringing before the public the great necessity for women doing women's work. He did not think ladies had ever before taken so much practical interest in these matters as they were doing now, and hoped this was but the first of a series of meetings which would show they could work for that object.

Miss Fanny Calder said that it had been found in the North of England that cookery could not be taught theoretically, and they had been considering how they could best teach and examine upon it practically. Grants for practical work of that description had been applied for, and Mr. Mundella promised to give the matter full consideration. Where the teaching had been theoretical it had been unsatisfactory. The inspectors had recommended that some plans should be devised for the adoption of new practical methods, in connection with South Kensington.

Paper read by **Dr Mann**, on "Domestic Economy, Defined and Arranged for Elementary School Teaching."

Mrs. Fenwick (member of Yorkshire Ladies' Counc of Education, and hon. sec. York County Cookery) advocated the appointment of lady for schools in domestic economy subjects, as had had a classical education could not be ex acquire the necessary knowledge of cookery and work. Influence should, therefore, be brought on the Government to appoint properly qualified inspectors.

Miss Phillips referred to the reluctance of pa attend classes, and urged that girls should not fused by too many subjects being brought before

Mr. Chadwick was an advocate for women women's work, and said the best work was schools which had female teaches. A great would be made by substituting for the teac childless wranglers, that of ladies who we accustomed to the work of their own families.

A paper was read by **Miss Andrews**, on "T of Domestic Economy in the bringing up of Children."

Mr. Chadwick remarked, on the question that on visiting a pauper school he had four pig being fed on the waste from the tables Pancras Workhouse there were cooking ra washing apparatus established, and everyt been systematised, with the result that 90 of the children now got good situations one-third formerly.

The meeting then adjourned for luncheon.

On the re-assembling of the meeting, **Mrs. B** the chair.

Mrs. Barnett read Mrs. Greenup's paper, Teaching of Domestic Economy in Schools."

Sir Henry Cole said it was mere pedantry that people could go through the world wi virtues, if they knew nothing about how t them. It was fallacious to hold, according to that until children had passed the fourth sta were not to be taught cleanliness, thrift, and He inquired of Lady Stanley of Alderney w was not of opinion that children three years not be taught something of domestic econo they knew anything of reading, writing, a metic.

Lady Stanley of Alderney thought it would teaching sewing and needlework at such a considered children would be much better rubbing their fingers in perfect liberty. Fo age was quite early enough for children to go

Miss E. M. Brant (Board School, Great Berk Herts) read a paper on "Method of Teaching Economy."

Sir Henry Cole thought that if young pe through such instructions as was advocat paper, girls taking domestic situations would prepared to fill them than at present.

Mrs. Ross (manager of a London Boar having spoken in favour of such instruction,

Mr. Alsager Hay Hill deprecated mere teaching, and suggested the promulgation o suggestions in the cheap popular newsp periodicals.

The Rev. E. F. M. McCarthy's paper, " tion and Inspection in relation to Domestic E was read by the **Rev. J. P. Faunthorpe.**

Mrs. Rowland Williams read a paper on " and Domestic Economy." (Second Branch.)

Mr. Faunthorpe protested against whole demnation of theoretical and the exclusive ad practical teaching. The mistresses leaving the

; necessarily know anything of cookery, ıalifications should be demanded of the they were required of the children.

.e read a paper on "Teachers' Certificates "

t **Martin** read a paper on "Domestic ıools and Training Colleges."

J. **Harrison's** (F.G.S.) prize paper, "The od of Teaching Domestic Economy in ary Schools," was read.

lisliked class legislation, that would make :he poor the acquirement of knowledge y, needlework, and general domestic h was not demanded of the rich. At)ulsory education imposed was obligatory

t urged that the teaching in these sub- e both practical and theoretical, and arted according to age, and not by der to reach dull girls.

differed from Miss Becker's views on .

nd the **Rev. J. P. Faunthorpe** added a y remarks, and the meeting terminated.

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g of Wednesday, 22nd June, was Royal Albert Hall, at 11 a.m., the NCER in the chair, and the Rev. E, assessor.

ECTION B.—NEEDLEWORK.

read a paper on "Needlework Certifi- ers."

zot de Witt's paper, on "The State of the Primary Schools of France," was allett.

; spoke specially in reference to needle- Birmingham Board Schools, and pointed ty of teaching the art of cutting out She had found children in the first ; seven years of age, able to knit stock- l materials in work might be used with in other ways a great deal might be done ldren's work "pretty" for them. One of s was having a number of cheap dolls children of standards 4, 5, and 6, and hat it would be a temptation to girls to r work if one of the dolls was given in , prize for the best work. To possess a ld, she believed, work steadily for a year.

ımmended that boys in infant schools ıt to use the needle, and learn to sew and ı the girls. Little boys got very tired were sewing, and the only resource was heir lessons to do over again. She had ›oys as young as 2½ years to knit, making to them to learn that they might sit up ; to bed, as they would have to do if they do something to occupy their fingers.

Price was requested by Lady Airlie to :hman in her employment was able to, . the stockings for his family. He quite sirability of boys being taught generally

l gave an instance of a school in Devon- boys were so instructed with advantage.

Price said that in the Duchess of Leeds' 'ere given for such work; and, on the : done by the boys was superior to that e girls.

Lady Stuart Hogg called attention to a remark by M. Le Gouvet, a great authority on educational matters in France, on the apparent inability of peasant men to find any occupation in the evenings beyond idly smoking; and the utility of giving them a means of employing their leisure in needlework of some kind.

Mrs. Dacre Craven remarked that in the Franco-German war, the Germans in hospital were able to occupy themselves usefully with the needle, while the French had great difficulty in passing the long hours. It would be well if boys in English schools were taught to sew and knit as in the German schools.

Rev. Newton Price said that one result of this Congress would be a recommendation to the authorities of the Educational Department in favour of the instruction of boys in these matters.

Miss Sempill's paper on "Simultaneous Teaching of Needlework" was read.

Rev. Newton Price gave an instance, on the authority of a lady present, of an old soldier having made, of his own design, from silk cuttings, a very fine patchwork quilt, which afterwards received the approval of the Duchess of Edinburgh.

Miss Cole's paper, "Notes on Clothing and Dress," was read by **Miss Stanley**.

Miss Kenrick suggested that the children should be put through examinations as to the amount and quality of the materials required to be made up into garments, and said that interspersing the lessons with questions for that purpose would enliven the dulness of the work. It was very desirable that children should be taught to combine colours tastefully, and so avoid the discordant results of ill-selected and badly arranged finery. Boys she could not admit to be quite so clever with the needle as they had been represented, but still much might be done in teaching them.

Miss Stanley offered a few remarks on the inculcation of ideas of suitability in dress to height, figure, and occupation. Students should be carefully instructed in those matters, and teachers should avoid appearing unnecessarily ornamented in their work.

Mrs. Floyer urged the necessity of a good example being set in matters of dress by teachers to the children in their charge.

Paper by Madame Van Eyck-Hardamann, read by **Miss Mallett**, "The Teaching of Plain Needlework in the Netherlands."

A Lady objected to so much time as six hours being given in the last standard to instructing girls who might be urgently wanted at home, and thought four hours would be sufficient.

Rev. Fredk. Lawrence (secretary to the Church of England Mourning Reform Association) offered a few remarks on the objects of that body, for which he asked support, and said that one of its objects was the abolition of crape for ladies as a sign of mourning.

Mrs. Erskine's paper, "Notes on Teaching of Needlework in Elementary Schools," was read by **Miss Stanley**.

Miss Curry's Paper, "How I Teach Sewing," was read by **Miss Webb**, and the meeting adjourned.

On the re-assembling of the meeting, a lecture was given by **Mrs. Floyer**, Demonstrator in Plain Needlework to the London Institute for the Advancement of Plain Needlework.

Mrs. Floyer said, with regard to the simultaneous teaching of needlework, as reading, writing, and arithmetic had for many years been taught in that way, it had occurred to her that the same method might advantageously be used in respect to needlework. The

question was, how was it to be done, and the first thing necessary was the adoption of a simple plan for avoidance of waste, and to render tools unnecessary as far as possible, the teacher always having the whole class at command. With the object of simplification, the method of hemming, for instance, had been reduced to six movements, and instead of being allowed to move their fingers in any way they pleased, they were instructed in position drill for their hands. This kind of instruction at once rendered children constructing, and not merely consuming, members of society. Specimens of work done after short periods of teaching were then referred to and explained. On the next subject of knitting much needless difficulty had been occasioned in teaching children, and they could be easily taught to do for themselves what was often done for them by teachers, in the shape of "casting on" and in other ways. Explanation was then given on the blackboard of a system for demonstrating proper modes of taking stitches, thus giving the children definite standards to work by. The great bugbear of teaching was how to teach classes of sixty or seventy children the way to cut out, in the absence of materials for them all. It had, therefore, been thought advisable to utilise the kinder-garten principle of using chequered slates, and it was found that the children had no difficulty in extending their work from the patterns after every three lessons. A great difficulty was to keep children clean who came from the poorest homes, and, in view of that fact, the cleanly appearance of the work shown was very creditable to the teachers. The importance of drill among children was really hardly understood. Teachers should recognise the necessity of self-drill in the first place, and its results would show themselves in the condition of their schools. Boys should be taught needlework as a means of giving them greater facility in the use of their fingers —a much needed requirement for them—for it was a common and true saying that "their fingers were all thumbs." Old copy-books might be used for making patterns. More specimens were then referred to, and the work analysed as showing the efficacy of the simultaneous plan of teaching. The most earnest application by the children was often stultified by the failure of their teachers to supply them with proper standards.

Paper read by the **Hon. Albertine Grosvenor**, on the "Watford and West Herts Association for the Improvement of Elementary Needlework in Schools."

Rev. Newton Price said formerly there was a great want of faith in the power of the inspectors' power of judging needlework, and teachers had candidly admitted that, until the association came into existence, needlework was very much neglected by them, knowing the inability of the inspectors to understand it, in favour of other subjects which would do them more credit, but since the efforts of the association had been pointed in this direction, the great progress made had astonished the managers.

Miss Phillips read a paper on "Needlework."

A Lady remarked that a great deal had been said about what was being done for the women of the future, and said she would be glad to hear what was being done for the grown-up women of the present.

Miss Allen read her prize paper, "Instruction in Needlework."

The evening meeting on Wednesday, 22nd June, was held at seven o'clock, at the House of the *Society of Arts*, when the chair was taken by Mrs. MANN, Sir H. COLE acting as assessor.

SECTION A.—FOOD: ITS COMPOSITION AND NU[TRITIVE] VALUE; ITS FUNCTIONS.

A paper, by Miss Buncle (Dumbarton), on " Teach Practical Cooking," was read by Miss Y

Sir Henry Cole said this lady had received one eight prizes awarded by the Society for a paper teaching of cookery.

The Rev. Nugent Price said a circular had be to her Majesty's inspectors with regard to the tion given in cookery and domestic econo matter having been very slightly dealt with in t book. When the results had been analysed and s it was intended to lay them before the E Department. Cookery was now taught in 300 including all the large towns except Mancheste inspectors themselves seemed very favourabl teaching of this subject, but he was sorry to some ladies would prefer that children should drawing or philosophy. He hoped that ev would be made to keep down the expense of cookery, and no attempt be made to turn ou for rich men's establishments. He was pro he was the first to introduce this subject into elementary school.

Sir Henry Cole said some years ago they pre Government Inspector to visit the School of Co he was much shocked at finding the chil taught to clean pots and pans. This gentlem author of the phrase "Culinary Treatment," of cooking, but he hoped it would soon give p proper term.

Miss Harriet Martin next read a paper Points Considered in Teaching the Second Domestic Economy," explaining in detail t of instruction followed in Whitelands Colleg

Sir Henry Cole thought the teaching of te carried out more perfectly at Whitelands where else.

Dr. Mann wished to draw attention to the this paper referred especially to the edu teachers. For many years he had been acqu this college, and it was quite marvellous wh were obtained there in a course of two years.

Dr. Frances Hoggan said, in listening to dishes mentioned, she had been sorry to n table dishes, especially as many of the teac going to neighbourhoods where there would amount of vegetable food at command. It possible to obtain everything requisite to bui body and repair waste from the vegetable king and it was, therefore, of great importance branch of cooking should receive due 2,500 vegetarian dinners were now given in London, and there was great difficulty ing cooks competent in this branch. be desirable, therefore, that where a class could be formed, a teacher of vegetaria should be specially engaged. She was a great for simplicity in everything, and preferred nitrogenous and non-nitrogenous foods in pl distinctions of flesh-forming and heat-produci recent researches had shown could not always tained.

Miss Martin admitted that it was an omissi have mentioned the cooking of vegetables, b simply for the want of space. All the gi taught how to boil a potato. She preferred t combustible or non-combustible, or oxidisable o oxidisable, as physiological terms, to chemical

Miss Barnett imagined that what vegetar quired was something more than the proper co a potato. She had frequently been asked for h producing a variety of vegetarian dishes, and ha them.

paper on "A Method of Teaching Cookery," by Clive Bayley, was next read.

Henry Cole said this subject of culinary treatment now been in public documents for some years, but were only two places where female teachers could taught cooking, and the department did not even that teachers should have a knowledge of cooking.

I. Barnett next read a paper on "Cookery and Teachers."

Cole said there were several points of great importance in this paper. It was very important that teachers of cookery should be well educated, but he know how that was to be secured.

lady suggested that a common kitchen as well as laundry should be placed at the top of model lodging houses. It would be a great benefit if the rich would see that the liquor in which poultry or meat was were given to the poor, instead of being thrown the sewers.

Mann next read a paper on "The Economical Establishment and Management of School Kitchens."

paper on "Domestic Cookery, as Taught to the of a Voluntary School," by Mrs. Debenham, next read.

Alan S. Cole then read a paper on "The Philosophy of Cookery."

Guthrie Wright wished to remark that all connected with schools would agree with Mrs. Mann cookery should be taught practically, and, she believed it was taught in that way. Edinburgh, they had not a special kitchen, endeavoured to make the conditions as nearly possible parallel to those which obtained their own homes. Strict attention was paid to of material, the object being not to make cooks, improve the cooking in the homes of the poor. were paid much attention to. The lessons consisted of twelve demonstrations, and were given to girls years old, and to those who had passed the fifth standard. Boys were also allowed to attend in some The teaching of Cookery in Training Colleges very great importance. It was very important to women of good education for teachers of cookery: not see how anyone else could teach it properly.

Henry Cole said a book might be bought for 1s. would show how to teach a child of four years of the rudiments of cooking, which he would recommend to the attention of the meeting. He explained the details which could be very easily conveyed young child's mind, and the practical operations in they might take part. The title of the book was Handbook of Home Life." He had to state on of a Diocesan Inspector that £5 was quite sufficient expenditure for utensils if some sort of cooking range were at hand. He believed cookery teaching failed from attempting too much.

next paper was on "The Importance of Teaching Children the Great Benefits to be derived from the Whole-meal Bread," by Miss Yates.

Fenwick thought the whole subject of domestic economy should be taught, not cookery alone. In they endeavoured to teach the whole subjects with it except washing, to which they had not attained. She suggested that the whole subject be considered necessary to the training of teachers cookery, as the whole was connected together. She details of the manner in which cookery was taught utensils which were employed.

W. S. Mitchell read a paper on "The Food Mission at Bethnal-green," and the advantages to be derived from a study of it.

After a few remarks from Mr. Clements, the Conference adjourned until Thursday morning at eleven o'clock.

MISCELLANEOUS.

GAS FOR LIGHT AND HEATING.

On Tuesday, June 14, Dr. C. W. Siemens, F.R.S., read a paper before the conference of gas managers held at Birmingham, on "Gas Supply, both for Heating and Illuminating Purposes." When, within the memory of living men, the gas-burner took the place of the oil-lamp, the improvement was so great that the ultimate condition of perfection appeared to have been reached. It is only in recent years that much attention has been bestowed upon the utilisation of by-products with a view of cheapening cost, and that the consumer has become alive to the importance of having a gas of high illuminating power, free from nauseous constituents, such as bisulphide of carbon, thus providing a stimulant for progress on the part of the gas-works manager. This condition of things has been rudely shaken by the introduction of the electric light, which, owing to its greater brilliancy and cheapness, threatens to do for gas what gas did for oil half a century before. The lighting of the City of London and of public halls and works furnishes proof that the electric light is not an imaginary, but a real competitor with gas as an illuminant; and it is indeed time for gas engineers and managers to look seriously to their position with regard to this new rival. For my own part (Dr. Siemens said), I present myself before you both as a rival and a friend—as a rival, because I am one of the promoters of electric illumination; and as a friend, because I have advocated the use of gas for heating purposes during the last 20 years, and am not disposed to relinquish my advocacy of gas both as an illuminating and as a heating agent. Speaking as a gas engineer, I should be disposed to regard the electric light as an incentive to fresh exertion, confidently anticipating achievements by the use of gas which would probably have been long postponed under the continued *régime* of a monopoly. Already we observe, thanks chiefly to Mr. Sugg, both in our thoroughfares and in our apartments, gas-burners producing a brighter light than was to be seen previously; and although gas will have to yield to the electric light the illumination of our lighthouses, halls, and great thoroughfares, it will be in a position, I believe, to hold its own as a domestic illuminant, owing to its convenience of usage, and to the facility with which it can be subdivided and regulated. The loss which it is likely to sustain in large applications as an illuminant would be more than compensated by its use as a heating agent, to which the attention of both the producer and the consumer has latterly been largely directed. Having, in the development of the regenerative gas furnace, had opportunities of recognising the many advantages of gaseous over solid fuel, I ventured, as early as 1863, to propose to the Town Council of Birmingham the establishment of works for the distribution of heating gas throughout the town; and it has occurred to me to take this opportunity (when the gas managers of Great Britain hold their annual meeting at the very place of my early proposal) to lay before them the idea that then guided me, and to suggest a plan of operation for its realisation which, at the present day, will not, I hope, be regarded by them as Utopian. The proposal of 1863 consisted in the establishment of separate mains for the distribution of heating gas to be produced in vertical retorts, that might be shortly described as Appold's coke ovens, heated by means of "producer" gas and "regenerators." The Corporation applied for an Act of Parliament, but did not succeed in obtaining it, owing to the opposition of the gas companies, who pledged themselves to carry out such an

undertaking, if found feasible by them. I am ready to admit that at the time the success of the undertaking would have involved considerable difficulties; but I feel confident that the modified plan which it is my present object to bring before you would reduce these difficulties to a minimum, and would open out a new field for the enterprise of those interested in gas-works. The gas-retort would be the same as at present, and the only change I would advocate in the benches is the use of the regenerative gas-furnace. This was first successfully introduced by me at the Paris Gas-works in 1863, and has since found favour with the managers of gas works abroad, and in this country. The advantages that have been proved in favour of this made of heating are—economy of fuel; greater durability of retorts, owing to the more perfect distribution of heat; the introduction of an additional retort in each bed, in the position previously occupied by the fire-grate; and, above all, a more rapid distillation of the coal, resulting in changes of four hours each, whereas six hours are necessary under the ordinary mode of firing. The additional suggestion I have now to make, consists in providing over each bench of retorts two collecting pipes, the one being set aside for illuminating and the other for a separate service of heating gas. I shall be able to prove to you, from unimpeachable evidence, that the gas coming from a retort varies very greatly in its character during progressive periods of the charge; that during the first quarter of an hour after closing the retort the gas given off consists principally of marsh gas (CH4) and other gases and vapours, which are of little or no use for illuminating purposes; from the end of the first quarter of an hour, for a period of two hours, rich hydro-carbons, such as acetylene (C2H2) and olefiant gas (C2H4) are given off; whereas the gases passing away after this consist for the most part again of marsh gas, possessing low illuminating power. According to the figures given in the experiment of M. Ellissen, President of the French Society of Gas Engineers, it appears that nearly two-thirds of the total production of gas takes place in the above period, while the remaining third is distilled during the first quarter of an hour and the last hour and three-quarters. It hence follows that by changing the direction of the flow of gas at the periods indicated, allowing the first results of distillation to flow into the heating gas main, then for two consecutive hours into the illuminating gas main, and for the remainder of the period again into the heating-gas main, one-third volume of heating and two-thirds of illuminating gas would be obtained, with this important difference, that the illuminating gas would be of 16·16 instead of 13·5 candle power, and that the heating gas, although possessed of an illuminating power of only 11·05 candles, would be preferable to the mixed gas for heating purposes in being less liable in its combustion to deposit soot upon heat-absorbing surfaces, and in giving, weight for weight, a calorific power superior to olefiant gas. The working out of this plan would involve the mechanical operation of changing the direction of the gas coming from each bench of retorts at the proper periods of the charge. In order to distribute the two gases a double set of gas mains would certainly be required, but these exist already in the principal thoroughfares of many of our great towns, and it would not, I think, be difficult to utilise them for the separate supply of illuminating and heating gas, the latter being only taken into the houses and establishments where it is asked for by the occupiers. The public could well afford to pay an increased price for a gas of greatly increased illuminating power, and the increase of revenue thus produced would enable gas companies to supply heating gas at a proportionately reduced rate. The question may be asked whether a demand would be likely to arise for heating gas similar in amount to that for illuminating gas; and I am of opinion that, although the present amount of gas supplied for illuminating purposes exceeds that for heating, the diminution in pric latter would very soon indeed reverse these pro Already gas is used in rapidly increasing quar kitcheners, for the working of gas-engines, fire-grates. As regards the latter applicatio here mention that an arrangement for using coke jointly in an open fireplace combined with contrivance for effecting the combustion of th heated air, has found favour with many of the grate builders and with the public. As reg use of illuminating gas, I have one more s to make, which I feel confident will be by you with interest. The illuminating effect in a gas flame depends partly upon the a carbon developed in the solid condition in the the flame, and partly upon the temperature these particles are heated in the act of co Having shown how by separation a gas o luminosity may be supplied, it remains to be the temperature of combustion may be raise may be effected by certain mechanical arran whereby a portion of the waste heat produce flame itself is rendered available to heat the air sustaining the combustion of the flame—s Fahrenheit, or even beyond this point. The ment I have adopted for this purpose is a bur ordinary Argand type, mounted in a small c chamber of sheet copper, connected with a ve of copper, projecting upwards through the the burner, and terminating in a cup-like ext a point about four inches above the gas orifice level with the top of the flame. A small mass of fills the cup, projecting upwards from it in a rou pointed form. The copper vessel surrounding t is contracted at its upper extremity with a directing a current of air against the gas-je burner, and on its circumference it is perforat admission of atmospheric air. The bottom formed of a perforated disc covered with wi and wire gauze also surrounds the circumfere perforated cylinder. The external air is heate ing through these "regenerative" surfaces, flame is thus fed with air, heated to the po indicated, which, by more elaborate arra might be raised to a still higher degree. T fire-clay in the centre of the burner, which is redness, serves the useful purpose of compl combustion of the gas, and thus diminishes th to blackening of the ceiling. The arrang transfering the heat from the tip of the flame supporting its combustion was applicable open bat's-wing burner, but I have not yet h ascertain accurately the amount of increase of l that may be realised with this class of burn a purely theoretical point of view, it can be s of the caloric energy developed in the coal gas a proportion (probably not exceeding 1 p really utilised in the production of luminous that even in the electric light nine-tenths of t set up in the arc is dispersed in the form of heat tenth only is utilised in the form of luminous would lead us too far here to go into the par these calculations, but it is important to call to them in order to show the large margin s us for practical improvements. I may here that another solution of the problem of he incoming air by the waste heat of the p combustion has lately been brought under pu by my brother, Frederick Siemens, whic essentially from the plan I have suggested, as he draws the flame downwards through apparatus, and thence into a chimney. In both these methods of intensifying a gas f probably find independent application, acc circumstances. By the combined employm process for separating the illumination from th gas with the arrangement for intensifying the l

gas flame, the total luminous effect produced by m consumption of coal gas may, according to the s given, be increased threefold, thus showing that eleterious effects now appertaining to gas illuminaare not inseparable from its use. My principal t in preparing this communication has been to call attention generally to the important question of proved gas illumination, and more particularly to bject of a separate supply for heating gas, which, ried into effect, would lead, I am convinced, to ficial results, the importance of which, both to gas panies and to the public, it would be difficult to estimate.

E CULTIVATION OF LAND IN KAZEROON (WESTERN PERSIA).

ll land in Kazeroon is private property. If the ivation be undertaken by the landowner himself, he to provide seed for an acre of one "gao" of cultin (the "gao" representing the extent cultivable one ox), viz., 1,000 lbs. of wheat and 1,000 lbs. y, and pay about 14 krans (the kran being equal l.) for the labour of ploughing and sowing. He in kind 11 per cent. of the yield of his harvest to nment, and 20 per cent. to the reapers, who have dertake all the duties appertaining to the collection harvest and the carriage into the stores of the rd. The landowner also pays 2 to 4 per cent. reshing or treading the corn. Other than a landr undertaking a cultivation has to pay to the landr 9 per cent. in kind from the out-turn of his st as rent for one "gao" of land, and 14 per cent. he Government as tax; his other expenses are the as those incurred by a landowner. Consulral Ross states that the agriculturists of Kazeroon of two classes, viz., the "ryot-i-padishah" and the -ryot, the former being always looked down upon all classes, and subjected by Government to more ession than the others. The ryot cultivator thus only pays more taxes to Government, but has ay his taxes in cash instead of in kind, and at 30 cent. above market value. He is also obliged to a certain quantity of straw to Government ials whenever required. A ryot, when a landr, and cultivating his own grounds, has to pay er cent. on his harvest in cash, and at the above eed valuation. A poor ryot pays about 60 krans lly in cash to Government; and there is another of ryots who are obliged to buy at 30 per above market value, a certain portion of the proreceived by Government as taxes. A wealthy ryot tirely at the mercy of the authorities, a sum of t 1,000 krans being annually levied from him. The e of one "gao" of land is from 100 to 600 krans, rding to the locality. To commence cultivation, an ay of about 15 tomains (the tomain being equivalent . 3d.) is necessary, and is distributed as follows:— ox, 50 krans; seed, 60 krans; labour, about 14 s; straw and cotton seeds, 16 krans; and sundries, rans. It is also necessary for a ryot when underng four or more "gaos" of cultivation, to maintain ast one donkey. The quantity of grain required cultivating one "gao" of ground is about 2,000 lbs. the case of "saifee" or summer cultivation, no distion is made by Government between a ryot and a n-ryot; "saifee" sowings are always undertaken by prietors of water and agriculturists conjointly, the protor providing the water and ground, and the agriculist finding the seed, labour, implements, &c. Should the er owner, however, not be a landowner as well, any er landowner would be but too glad to permit his ds to be used for "saifee" cultivation gratis, inasch as the soil becomes enriched by manuring, which "saifee" cultivation necessitates. The time taken "saifee" sowing is about seven months, the following being cultivated — tobacco, water melon, marsh melon, vegetables, cotton, sesame seeds, lentils, rice, gram, &c. A tax of 20 per cent., *ad valorem*, on the out-turn, is levied by Government, three-fifths of which is payable by the proprietor of the water, and two-fifths by the cultivator, and the balance is equally divided between the proprietor and the cultivator. Rice and grain, however, form an exception, and are cultivated under the following conditions:—The agriculturist recoups himself for the quantity of seed supplied by him after harvest. He then has equal shares with the water owner, who alone pays Government taxes as follows: — If a ryot, he pays three-fifths of his share to Government; if a non-ryot, he pays only half, the agriculturist paying no tax on his share. In all cases it is thoroughly understood that the Government share of the produce is to be carried to Government store at the cultivator's expense. The approximate value of the produce on the spot is for wheat, from 40 to 60 cents. per maund (the maund being equivalent to 3 lbs. avoirdupoids); barley, from 25 to 30; gram, from 50 to 80; sesame, from 70 to 100; maithee, from 15 to 20; dhall, from 15 to 20; cotton, from 2½ to 3 krans; and rice, from 50 to 80 cents. The annual expenses of a ryot cultivator in Kazeroon, with a wife and two children, are 10 tomains per annum. The yield of wheat and barley is from ten fold to twelve fold in a good year, and three fold to four fold in a bad one; rice, in a bad year, yields twenty fold, and in a very good year, sixty fold; cotton, five fold in a bad year, and ten fold in a good year. Irrigation is generally conducted by means of kanats, and the water in all cases is allowed free passage across grounds, even though not belonging to the proprietor of the kanat; should the proprietor of a kanat not wish to undertake any "saifee" cultivation, he could still be made liable by Government to such taxes as may be due by the cultivator; no taxes whatever are levied on gardens in Kazeroon. In the cultivation of the poppy, which is largely grown, the proprietor provides the land, seed, and the expenses of sowing, the cultivation is then made over to the ryot, who undertakes all the labour necessary for the tending of the crop till the season of cultivation, when the proprietor pays for the labour of incision, about one kran per man per day; the out-turn is then equally divided between the landowner and the ryots. The cultivation of opium is also untaxed. A good deal of water is wasted in Persia owing to the long distances it has very often to travel before reaching a land eligible for its security against raids, &c., and to damages constantly sustained by watercourses, which, owing to the social conditions of the country, it is very often beyond the reach of the ryot to travel out of the jurisdiction of his village to repair. There are also large tracts of fertile land which remain waste owing to their proximity to the main roads, as no village having cultivators on such spots can possibly prosper or enjoy the least immunity from the exacting demands of Government officials, and the thefts and robberies committed by the "Iliyat" tribes on their passage along the country thoroughfares.

NOTES ON BOOKS.

Melbourne International Exhibition, 1881. The Official Catalogue of the Exhibits, with the Introductory Notices of the Countries Exhibiting. Melbourne, 1880. 2 vols., 8vo.

This is a second edition of the catalogue, and contains a complete record of the exhibits. The general classification adopted consisted of 82 classes in ten groups:—

Group 1. Works of art; 2. Education and instruction, apparatus and process of the liberal arts; 3. Furniture and accessories; 4. Textile fabrics, clothing and accessories; 5. Raw and manufactured products; 6. Machinery, apparatus and processes used in the mechanical industries; 7. Alimentary products; 8. Agriculture; 9. Horticulture; 10. Mining industries, machinery and prducts. Prefixed to the list of exhibits of each Court is a statistical account of the country which sent them.

GENERAL NOTES.

National Training School of Music.—A series of students' concerts is now being given in the arena of the Albert Hall. Future concerts will be on the afternoons of Wednesday, June 29, Friday, July 8, Wednesdays, July 8, and 20, commencing at 4 p.m. The public will be admitted to these concerts on payment of 1s., but students will be supplied with tickets for their friends gratis.

Ecclesiastical Art Exhibition at Newcastle.—An Exhibition of Ecclesiastical Art will be held at Newcastle-on-Tyne during the meeting of the Church Congress from October 3 to 8. The Exhibition will include articles of every description used in the building and adornment of churches, or in connection with the services thereof—stone and wood carving, stained glass, brass and metal work, gold and silver plate, bells, embroidery, tapestry, organs and harmoniums, church chairs, mosaics, &c., a large gallery being set apart for the display of cartoons, designs, pictures, architectural drawings, &c. It has been decided to admit also all kinds of school applicances, books, &c., useful in the furtherance of education. There will be also an extensive loan collection of pictures, photographs, designs (old and new), embroidery, carvings, and objects of ecclesiastical art generally. Applications for space, or permission to exhibit, should be addressed to Mr. J. Hart, manager, Ecclesiastical Art Exhibition, 33, Southampton-street, Strand, London, W.C.; or Mr. G. J. Baguley, 45, Carliol-street, Newcastle.

Gold in the United States.—According to a report of the Director of the United States Mint lately issued, the total gold circulation of the United States, including bullion in the Treasury, amounted, at the commencement of May, to 520,000,000 dollars, of which about 264,000,000 dollars was held as Treasury and national bank reserves, and 256,000,000 dollars was in actual circulation. There has been a total gain of gold coin and bullion to the country since July, 1879, of 234,000,000 dollars, of which 35,000,000 dollars was added to the Treasury, 59,000,000 dollars to the banks, and 140,000,000 dollars to the active circulation. The total amount of gold in the country makes a fair showing compared with the principal countries of Europe, being exceeded by only two. The amount estimated to be in England in 1880 was 596,000,000 dollars, of which 428,000,000 dollars was in actual circulation; and France, with 927,000,000 dollars of gold, had a circulation of about 816,000,000 dollars. The larger proportion of gold in active circulation in the latter two countries the director attributes in part to the fact that their coinage consists most exclusively of denominations of less value than 5 dollars. The largest English gold coin is the sovereign, equivalent to 4·86½ dollars of American money, while in France, out of a total coinage during the last 77 years of 1,743,288,000 dollars of gold, nearly 99 per cent. was in pieces of less than 5 dollars.

Oyster Culture in Tasmania.—A successful attempt to breed oysters in a bed specially prepared for their reception appears to have been made in Tasmania, at a place bearing the appropriate name of Little Oyster Cove, where a number of these bivalves were placed towards the end of last year, in the expectation that they would "spat" or spawn in the month corresponding to the month of July, which is the breeding season of the European oyster. It ever, till the middle of February that the usu a "heavy fall of spat" were observed, the wa to be full of the minute oysters just extruded f shells. In March an examination was made which had been placed to collect the young they were found to be thickly covered with m If any reasonable proportion of these moll maturity, there is every prospect of the sci culture being carried out in a most success Tasmania. The total number of young oys February in Little Oyster Cove is variously have been from 2,500,000,000 to 40,000,000,00 per cent. come to maturity and market four ye enterprising Colonist who conducted the exp to reap a rich reward.—*Colonies and India.*

MEETINGS FOR THE ENSUING W

MONDAY, JUNE 27TH...Anglers' Association (at th SOCIETY OF ARTS), 8½ p.m. Conferen Water Fisheries Act.

Royal Institution, Albemarle-street, W., 5 Monthly Meeting.

Royal Geographical, University of Lond gardens, W., 8½ p.m. Lieut.-Colonel "The Country of the Tekke Turkomans and Murghab Rivers."

Public Analysts, Burlington-house, Piccad Special General Meeting to Consider Alte 1. Mr. A. Wynter Blyth, "The Estima in Wines and Tinctures, &c." and " Patterns which drops of various Fat certain conditions." 2. Mr. W. F. K. St fication of Wynter Blyth's Apparatus f Ether as applied to Milk Analysis," and ' for Griffin's Gas Muffle Furnace." 3. "Some remarks on the Swedish Laws a of Arsenic really Prohibited."

TUESDAY, JUNE 28TH...National Health Society (a THE SOCIETY OF ARTS), 7½ p.m. Mr. S. "The Science and Art of Sanitary Plum IV.) "House Drainage and Ventilation

Statistical, Somerset-house-terrace, Stran Annual Meeting.

Anthropological Institute, 4, Grosvenor- 8½ p.m. Right Hon. Sir H. Bartle Frer Laws Affecting the Relations betwee Savage Life, as Bearing upon the Deali with Aborigines."

Royal Horticultural, South Kensington, 8.

WEDNESDAY, JUNE 29TH...SOCIETY OF ART Adelphi, W.C., 4 p.m. Annual General

THURSDAY, JUNE 30TH...Victoria Institute (at the SOCIETY OF ARTS), 8 p.m. Annual Mee by the Right Hon. the Lord O'Neill.

Society for the Encouragement of Fine Ar street, W. Morning Meeting.

FRIDAY, JULY 1ST...National Health Society (at the SOCIETY OF ARTS), 7½ p.m. Mr. S. St "The Science and Art of Sanitary Plumb tition of Lecture IV.)

Royal United Service Institution, Whitehal Major J. C. Ardagh, "The Austrian Arm

Geologists' Association, University Colleg

L OF THE SOCIETY OF ARTS.

No. 1,493. Vol. XXIX.

FRIDAY, JULY 1, 1881.

cations for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

EEDINGS OF THE SOCIETY.

ANNUAL GENERAL MEETING.

nnual General Meeting, for receiving the om the Council, and the Treasurers' State- Receipts, Payment, and Expenditure e past year, and also for the Election of was held, in accordance with the Bye- Wednesday last, the 29th of June, at ., F. J. Bramwell, F.R.S., Chairman of cil, in the chair.

cretary read the notice convening the and the minutes of the previous annual eeting.

owing candidates were proposed, balloted luly elected members of the Society:—

Percy Leonard, 8, Arboretum-street, Derby, gineers' Office, Northern Division, Midland ', Derby.
, David, M.P., 25, Pont-street, S.W.
William James, Farnley-house, Chelsea,
Edmund Bowen, 51, Courtfield-gardens, South ton, S.W.
hn, Maple Durham, Oxon.
James Barnes, 77, Old-road, Middleton, near ter, and Jessamine-house, Barton-on-Irwell, ire.
Robert Charles, 10, Henry-street, Carlisle.
ercy Wilson, 14, Augusta-road, Ramsgate.
eorge Bernard, M.D., 3, Chesterfield-street, , W.
Horatio, St. Lawrence, Putney-hill, S.W.
C. F., City Surveyor's office, Manchester.
William, Caterham.
et, Worcester.
William Alfred Harry, Coombe Croft-house, am.
W.B., Keythorpe-hall, Leicester.
Henry Somerson, 1, The Elms, St. Ann's-ndsworth-common, S.W.
G. W., Esthwaite-lodge, Hawkshead, near de.
G., 24, Bull's Head Exchange-chambers, place, Manchester.
, William, Stoneleigh, Sale, Cheshire.
entz Albert, 97, Finsbury-pavement, E.C.
Carlo, 115, Piccadilly, W.
Samuel, 11, Queen Victoria-street, E.C.
Everard, Dartford, Kent.
Matthias Thomas, 77, Chancery-lane, W.C.
Johnson, Thomas Hilton, F.C.S., 36, Rawcliffe-road, Rice-lane, Walton, Liverpool.
Johnston, Thomas Ruddiman, F.R.G.S., 108, George-street, Edinburgh.
Jones, Charles, 35, Great Queen-street, Lincoln's-inn-fields, W.C.
Kennard, Stephen P., J.P., 17, Kensington-palace-gardens, W.
Lassetcr, Frederic, 5, Porchester-gate, Hyde-park, W.
Lloyd, Alfred, B.A., Bush-lane, Cannon-street, E.C.
Nosotti, Charles, 395, Oxford-street, W.
Olsen, Ole Theodor, F.R.A.S., 40, Cleethorpe-road, Grimsby.
Owen, Lancaster, 38, Gloucester-gardens, W., and Engineers' Office, G.W.R., Paddington, W.
Paul, Joseph John Dawson, Eaton, Norwich.
Pfeil, A. L. A., Frognal, Hampstead, N.W.
Phillips, Alfred, 23, Cockspur-street, S.W.
Rutson, Albert, 7, Half-moon-street, Piccadilly, W.
Saunders, H. A. C., 11, Old Broad-street, E.C.
Stevenson, George Ernest, The Gas Works, Peterborough.
Thomas, Sidney Gilchrist, F.C.S., 27, Tedworth-square, Chelsea, S.W.
Tweddell, Ralph Hart, 14, Delahay-street, Westminster, S.W.
Tweedie, George R., F.C.S., 24, Josephine-avenue, Brixton-rise, S.W.
Walker, Philip F., 29, Prince's-gate, S.W.
Wickham, William Henry, 14, Essex-street, Strand, W.C., and Wimbledon-hill, Surrey.
Williamson, William Blizzard, Providence Works, Worcester.
Young, Charles Edward Baring, 12, Hyde-park-terrace, W.

The Chairman nominated Dr. Mann and Capt. C. F. Gardner scrutineers, and declared the ballot open.

The Secretary then read the following—

REPORT OF THE COUNCIL.

The Council have now to lay before the members their report for the One Hundred and Twenty-seventh Session of the Society, and, in doing so, they are happy to be able to repeat the congratulations which their predecessors in office have now for some years past been justified in offering to the general body of members. The Society is, they are glad to think, flourishing in every way; its numbers are increasing, now for the first time for some few years, its finances are in a sound condition, its usefulness is as great as ever, and the Council are well assured its influence is as widespread and its reputation as high as at any period of its long and prosperous career.

I.—Ordinary Meetings.

Looking back through the list of papers read at the ordinary meetings of the past Session, it is satisfactory to be able to state that neither in popular interest nor in intrinsic value, do they compare unfavourably with those read in any former Session.

It has been the aim of the Council always to give the members the earliest possible opportunity of hearing, from the lips of the discoverers themselves, or of other competent persons, accounts of the various applications of science to purposes of daily life, of which our time is so productive. It is not now-a-days possible, or even desirable, for a Society to compete with the public newspapers as

an instrument of early intelligence. The public receive the first information of any scientific discovery from the daily Press, but they are also anxious for fuller information than can be supplied to them by such a channel; while, in many cases, they are glad of the opportunity of seeing the actual appliances by which the discoveries were made, or by which they are to be turned to practical account. It is, doubtless, this desire which draws to our room the large audiences which assemble there whenever any new advance in science, or any fresh application of science, is described. To chronicle such progress, to assist it, to make it known, these are the most important functions of our Society. If proof of this were wanting, the numbers attending our meetings alone would afford such proof, since whenever any new subject of scientific interest comes on for discussion, immediately the limited extent of our accommodation shows itself, and the difficulty of providing for our large numbers makes itself felt. Thanks to the many eminent men of science who have readily come forward to place their knowledge at the disposal of our members, there has been, during the Session now just finished, no lack of such papers.

Nor have the discussions, on the whole, been less satisfactory. With so many competing means of diffusing information, it can hardly be expected that the discussions at scientific societies should occupy the place they once did, and it is all the more satisfactory to see the high character of our discussions still kept up. Indeed, those of the past year show an advance on those of some previous years. It cannot but happen occasionally, that a discussion will fall into the hands of members not specially qualified to deal with the subject, whatever it may be, and when this is so, there comes a natural reluctance, on the part of those who really are so qualified, to take a share in it. The Council, however, think they are justified in stating that the discussions of this Session have, on the whole, been kept at rather a higher level than they have attained of late, for while there has been an equal readiness on the part of those who know to impart their knowledge, and to criticise; there has been, on the whole, less of that tendency which more or less characterises all public meetings—to talk more for the sake of talking than for any better reason.

After the opening meeting of the Session, at which Mr. Bramwell gave the usual address as Chairman of the Council, the first paper read was by Mr. Comyns Carr, on "The Influence of Barry upon English Art." This seemed a desirable opportunity, after their restoration, to draw special attention to the great masterpieces of Barry, which have now adorned the meeting-room for nearly a hundred years, and the subject was ably handled by Mr. Carr.

For the next meeting, fortunately, the aid of Professor Graham Bell, who happened to have come to England on a short visit, was secured. Professor Bell readily acceded to the invitation of the Council, that he should bring the Photophone, his latest and one of his most wonderful discoveries, before the Society, in the same manner as, four years ago, he had introduced his earlier invention, the Telephone. His paper was listened to by a crowded meeting, and the inadequacy of the accommodation possessed by the Society for the reading of more than usual interest was a[…] evident, for it was unfortunately im[…] accommodate many members who wis[…] present. The room, however, was fi[…] utmost capacity by an appreciative and audience. The principles on which M[…] worked had been, a few days before, bro[…] the notice of the Royal Society, and th[…] his discoveries had of course been mad[…] means of the newspapers; still his pape[…] was really the first introduction to [...] audience of this latest and most marve[…] lopment of Mr. Bell's inventive ingenui[…]

The practical applications of electricit[…] formed the subject for two other papers […] present Session, and the attendance at t[…] of both these papers showed that the int[…] by the public in this important ques[…] the increase. In March, Mr. Preece […] account of the recent advances in Electric […] a paper which formed a very apt […] the series of Cantor lectures on the sam[…] which were delivered by Professor Ad[…] date for Mr. Preece's paper was arrang[…] it followed immediately after these lec[…] by this means it was possible to use […] the paper and for the lectures a n[…] machines and lamps which were, by the […] of the proprietors, placed at the dispo[…] Society for the purposes of illustration. […] Robey, of Lincoln, were good enoug[…] an excellent steam-engine, for the p[…] driving the machines, and the Cou[…] at some trouble and expense in arra[…] various apparatus, so as to give the m[…] good an opportunity as space and time […] of examining the latest means of […] the electric light. A more recent, but […] wonderful application of electricity, is to […] mission of motive power. An excellent […] this subject was read at the last ordinar[…] but one of the Session, by Mr. Alexande[…] Mr. Siemens began by dealing with the t[…] principles involved, and gave the results […] series of fresh experiments which have b[…] carried out under the direction of Messr[…] Bros. in Berlin. He then went on to d[…] arrangements used for the electrical rail[…] trating his description by a working mo[…] apparatus. The paper gave rise to a very […] discussion, which, indeed, had to be car[…] the following Wednesday evening, the[…] cluding the business of the Session.

Dr. Alfred Carpenter's paper on "Lond[…] read at the beginning of December, wa[…] seasonable, and this, as well as the la[…] read towards the end of January by […] Moncrieff, on a similar subject, attract[…] siderable amount of public attention.

At the last meeting before Christmas, […] Edwards, the Secretary to the Deputy-Ma[…] Trinity House, read a very able paper on "[…] by Means of Sound." The meeting at […] paper was read had the advantage of […] sided over by Dr. Tyndall, and near[…] principal authorities on this subject atte[…] took part in the discussion. Mr. Edw[…] an interesting account of the measures […] been taken by the Trinity House for […]

ınd signals, to the safety of our coasts. ubject was dealt with in March by Thomson, who brought before the system he has for some time been of enabling each lighthouse to identify ssing ship by means of a special signal. ;ave rise to a long and valuable dis- ch indeed may be said to have done owards the clearing up of a difficult ated question.

Christmas recess, Professor Fleeming oduced, to a London audience, a nsuring the proper sanitary condition hich he has for some time successfully at Edinburgh. Professor Fleeming er led to the formation of an association the Edinburgh Sanitary Protection and the Council understand that this, e or two others of a similar description, g favourably.

's paper on "Success and Failure in d Mining" gave a good account of the ually adopted for the extraction of the s ore; and also quoted the author's views tions in system and process which were The great severity of the winter about s such as to render Mr. Lock's audience y small one, and hardly more success d at an adjourned meeting for the of the paper. The paper, however, ch interest, the subject being one e members are aware, was then and cting a great deal of attention. Mr. urne's paper on "Trade Prospects" of several dealing with social and eco- ics, rather than with scientific matters. hat many of our members are interested this character, and it is thought that advantage results from the opportunity for the discussion of such subjects. is class may be enumerated Mr. Sedley er on "The Participation of Labour in of Enterprise;" Professor Bonamy "Buying and Selling;" and Mr. hnson's paper upon the "Trade Marks Acts." The first and principal Act en at work for five years, and the g which it is possible to register an de mark has therefore expired. This good opportunity for Mr. Johnson to results of the working of the Act, t out various improvements which, in and in that of other authorities, seem ble. There was also a paper upon s," by Mr. Cornelius Walford, who esults of careful research into the the subject for a long time back.

cations of Art to industry have always of the most important departments of 's work. Nor has it been neglected ction of papers for reading at the eetings. Under this head are to be Hungerford Pollen's paper on "The Art arving," read in February; Professor n "The Artistic Use of Precious d a little later in the Session; and, d of the Session, the paper by Mr. ll, of the Whitefriars Glass Works, Manufacture of Glass for Decorative

The papers yet remaining to be noticed include one on "River Conservancy," by Mr. Cresswell, a subject of which he has treated before in the Society's Room, and one which has for some years attracted special notice from the Society. Next came a paper by Mr. Edward Whymper, giving an account of the writer's ascents of Chimborazo and Cotopaxi last year. In this case, as in that of Professor Bell, it was found absolutely necessary to restrict the admissions, but in order to give the greatest possible number of members the opportunity of hearing Mr. Whymper, the loan of the lecture theatre at South Kensington was obtained for the evening, through the kind permission of the Lords of the Committee of Council on Education.

II.—Indian Section.

The Indian Section has had a most successful Session this year, all the papers being of a high character, and some of them extremely important. The work of the Section began with a communication from Sir Richard Temple, on "Forest Conservancy in India." This is a subject with which Sir Richard Temple has been closely connected, and the paper which he read upon it was both interesting and important. Had it not been that the meeting took place during the week of the severe snow-storm, which, for a time, almost suspended traffic in London, the audience would, doubtless, have been larger than it was, but, even under these unfavourable circumstances, the reading of the paper was well attended. Mr. Hyde Clarke's paper on the "Indian Gold Fields," read at the next meeting of the Section, formed a valuable and indeed a necessary supplement to the paper previously read by Mr. A. G. Lock, on a similar subject, at one of the ordinary meetings of the Society. Mr. Lock, of course, had dealt with the question of gold mining generally, while Mr. Hyde Clark treated the special subject of the "Gold Fields of India." The third paper was an admirable exposition of "The Results of British Rule in India," by Mr. J. M. Maclean, who is recognised as an eminent authority on the subject. Sir George Campbell followed with a subject with which his name has long been connected —"The Tenure and Cultivation of Land in India." The fifth paper was by General Maclagan on the "Building Arts of India," while the sixth and concluding one was by General Sir Arthur Phayre, on "British Burma." This paper is really a model of complete information in a concise form. It has been suggested at different times that it would be useful if a selection were made from the papers which have been read at the various meetings of the Indian Section since its formation, with a view to its separate publication. The Council do not feel themselves able at present to offer any opinion on this matter, but they propose to take it into further consideration.

III.—Foreign and Colonial Section.

In the Foreign and Colonial Section the business of the Session commenced by a paper on "The Industrial Resources of South Africa," by Sir Bartle Frere, G.C.B., who opened the section seven years ago with an inaugural address. This paper was notable for the large amount of valuable information supplied regarding the

progress and prospects of a district to which recent events have so strongly drawn public attention. Mr. Cust also contributed an interesting sketch of the classification and structural relations of the languages of Africa, in the discussion of which Dr. Koelle, the distinguished philologist, took a prominent part. An account of the present state of the diamond fields of South Africa, and the progress of their operations, was communicated by Mr. R. W. Murray, who had been connected for ten years with the district. Mr. Hepple Hall's memoir of the colony and dominion of Canada was most suggestive and practical, containing as it did an admirable historical sketch of the commercial progress of this important dependency. Mr. Westgarth's remarks on the trade relations that connect her colonies with Great Britain, excited a considerable amount of attention, and led to a lively discussion. The immediate interest of Mr. Gubbins' paper upon Loo Choo, and its curious two-fold connection with the Empires of China and Japan, was materially increased by the presidency of Sir Harry Parkes, K.C.B., her Majesty's Minister at the Court of Japan, and by his promise of a future contribution to the Section concerning the commerce of the country with which he is officially connected.

IV.—Section of Applied Chemistry and Physics.

Five papers were read in this Section; a sixth had been set down upon the list, but the sudden and severe indisposition of the author of it, Mr. Shelford Bidwell, prevented its being read. In the first paper, Mr. James Mactear gave an account of his system of manufacturing sulphate of soda. It will be in the recollection of the members that, three years ago, Mr. Mactear described to the Society the furnace known by his name, at a meeting of the Chemical Section, in a paper for which the Council awarded a medal at that time. In his second paper, Mr. Mactear described the various improvements which he has since made in his furnace, with the object of rendering its action continuous. The second paper read in the Section was by Mr. J. Y. Buchanan. Mr. Buchanan is well known as having occupied the position of chemist to the *Challenger* expedition, and the experience he then gained enabled him to write a very valuable paper upon "Deep Sea Investigation, and the Apparatus Used in it." The paper may be said to be fairly exhaustive of its subject, and, it may be hoped, will take rank as a monograph upon it. This was followed by a paper by Professor Perry, on "The Future Development of Electrical Appliances." The subject of Professor Perry's paper may be said to be the application of electricity to purposes other than illumination. The same remark applies to it as has been applied to papers on electrical subjects read before the ordinary meetings of the Society—that it attracted much attention from the members, and brought together large audiences. Mr. Stillingfleet Johnson dealt with a subject which has frequently of late been before the Society in his paper on the effects of impure water upon health; while Professor Huntington concluded the business of this Section by an able *resumé* of recent progress in the manufacture and application of steel.

V.—Cantor Lectures.

It has been the practice of recent years t for three sets of Cantor lectures in eacl each set consisting of some five or six le is hardly necessary to say that most of th with which the Cantor lectures deal are it would be difficult to deal with them cc even in much longer courses; but, on hand, it is often inconvenient for member arrangements to attend week by weel extending over a period of six weeks. Session just passed, therefore, arrangem made for a greater number of courses, courses themselves were made up of number of lectures. There were accord series of Cantor lectures. Of these, the delivered by Professor Church, his subj "The Scientific and Artistic Aspects of and Porcelain." These lectures wer during the early part of the Session, to Christmas, and were well attended. course after Christmas was by Mr. Rigg, the subject being "Watchmaking course also attracted good audiences; on former occasions, when the subject of of lectures was connected with any Lond a limited number of admissions were watchmakers and their apprentices, many availed themselves of the opportunity of a their knowledge of the theory of their busi Rigg's lectures were specially valuable f want of technical literature in this countr subject of watchmaking; and this fact wi their value when they make, as they shor their appearance in the *Journal*. The larg ences at the Cantor lectures of the Session, l were those which attended the third course Scientific Principles Involved in Electric ing" by Professor Adams. For these tl was crowded to its utmost capacity. Prof. lectures were amply illustrated by a fine of apparatus, and also by examples of sever principal systems of electric lighting. Of systems, the Brockie lamp, Siemens la Serrin lamp were shown at work, other la "candles" being exhibited, but not lighte interest also attached to the exhibition Swan of his new incandescent ligh next course was by Mr. Alan S. Cole, u "Art of Lace-making." These lectures w illustrated by some valuable specimens of l for the purpose, and also by a fine coll transparencies, representing the various tions of lace, which were shown on the sc the aid of a lantern. The Cantor lecture Session were concluded by an important c "Colour Blindness," delivered by Mr. R. B Carter. Mr. Carter drew special attentio effect of colour blindness upon various in and brought before his audience the test have recently been devised for the d of this curious defect. The Council think to say that Mr. Carter, being a member of could not accept the usual fee for his lectu

VI.—Juvenile Lectures.

In these lectures, the Council have alw deavoured to consider rather what wo interesting and instructive to the youthfu

ıan to strictly confine the range of the to subjects properly coming within the f the Society. They, therefore, invited Mr. omanes, the well-known naturalist, to give ıal short course of lectures at Christmas, subject which he has made his own, the ence and instinct of animals. The lectures ry well attended, and appeared to afford tisfaction to the audience that listened to

VII.—ALBERT MEDAL.

Council feel convinced that the award of ert Medal, this year, to Dr. A. W. Hofmann, "for the eminent services rendered to the al arts by his investigations in organic ry, and for his successful labours in pro- the cultivation of chemical education and ı in England," will give universal satisfac- For the past forty years, Dr. Hofmann, one ig's earliest and most distinguished pupils, oured with an indefatigable zeal, equalled the success of those labours, in the develop- some of the most important branches of chemistry. While the very high scientific f Dr. Hofmann's researches has been, from time, recognised in this country by the o him of the Royal and Copley Medals of yal Society, and of the Faraday Medal of mical Society, the fact that some of his markable researches laid the foundation of -tar colour industry, while others furnished nt contributions to its rapid development, itly recognised by the award of the Albert f the Society of Arts.

are, however, other quite separate and y not less prominent claims to this distinc- ich the Society of Arts desire to recog- warding the medal to Dr. Hofmann. When ege of Chemisty was established, in 1845, R.H. the late Prince Consort as its ardent and Dr. Hofmann as its first Professor, the s for the acquisition of chemical knowledge ents in this country were of a very limited and within the reach of but few; and the ; requisite for the pursuit of chemistry as a or profession, and for its application to ctures and the Arts, had to be sought in y and France. It is due to the indefatigable ıs and perseverance of Dr. Hofmann, in the nost formidable difficulties—to his remark- wers as a teacher and lecturer, and to the peculiarly his own, of inoculating his rith his enthusiastic love of chemical re- that the Royal College of Chemistry r became developed into a world-renowned of chemical science; while its success im- a great impetus to the cultivation of that and of its application to the Arts and ctures of the United Kingdom. Among English chemists who have, in later years, ıously contributed to the development of l industries and to the advancement of l knowledge, some of the most prominent ıd to claim as their master the eminent pon whom the Society of Arts now its highest distinction.

VIII.—MEDALS.

ding to the usual custom, the Council have awarded Silver Medals for certain of the papers read during the Session before the Society, at the ordinary meetings and in the different Sections. For the present year, eight medals have been awarded; of these, three were given for papers read at the ordinary meetings, two for papers in the Indian Section, one for a paper in the African Section, and two for papers in the Chemical and Physical Section. The Council also passed a vote of thanks to one of their own members, Mr. Preece, for the very interesting paper which he read, upon "Recent Advances in Electric Lighting." The following is a complete list of the awards:—

To Professor ALEXANDER GRAHAM BELL, for his paper on "The Photophone."

To E. PRICE EDWARDS, for his paper on "Signalling by Means of Sound."

To ALEXANDER SIEMENS, for his paper on "The Electrical Railway, and the Transmission of Power by Electricity."

To Sir RICHARD TEMPLE, Bart., G.C.S.I., C.I.E., D.C.L., for his paper on "Forest Conservancy in India."

To J. M. MACLEAN, for his paper on the "Results of British Rule in India."

To Sir HENRY BARTLE EDWARD FRERE, Bart., G.C.B., G.C.S.I., D.C.L., LL.D., for his paper on "The Industrial Products of South Africa."

To J. Y. BUCHANAN, F.R.S.E., F.C.S., for his paper on "Deep Sea Investigation, and the Apparatus used in it."

To Professor JOHN PERRY, for his paper on "The Future Development of Electrical Appliances."

IX.—EXAMINATIONS.

Those who have interested themselves in this department of the Society's work, are aware that considerable changes were made in the examinations, after due announcement, a year ago, many of the subjects in which examinations had been held being struck off the list. The reasons which induced the Council to take this step have been fully stated in the *Journal*, and in previous annual reports. The past year was the first under which the new system came into practice. According to the plan adopted, only those subjects were retained in which it did not appear that any other examination was provided for students, the subjects retained being Clothing, Cooking, Health, Housekeeping, Political Economy, and Music. In all these subjects, except in Music, there has been a serious falling off, the numbers of candidates for the present and for last year being as follows:—

	1880.		1881.
Clothing	84	..	3
Cookery	118	..	95
Health	114	..	42
Housekeeping	50	..	14
Political Economy	40	..	27
Music	324	..	321

The cause of this diminution is doubtless to be found in the fact that the abandonment of the greater number of subjects has reacted on those retained, for many candidates who took up some of the latter as supplementary, do not now enter at all. In former examinations a separate day was given for each of the Domestic Economy subjects; there is now only one day for the whole number.

The Council are much indebted to the Science

and Art Department for the assistance which they have rendered, in permitting candidates for the Society of Arts Examinations to be examined in connection with the candidates at the Government Examinations.

X.—Prince Consort's Prize.

The Prince Consort's Prize of Twenty-five Guineas, originally offered by his Royal Highness the late President of the Society, and graciously continued by her Majesty the Queen, was offered annually to the candidate who, obtained under certain conditions, and within a space of four years, the greatest number of First-classes in the subjects for examination. The altered scope of the examinations rendered it necessary for the Council to ascertain her Majesty's wishes in respect of the prize, and she gave it as her opinion, that as the system of education, which the Prince Consort had desired to encourage, was now to a large extent carried on by the Science and Art Department, the time had arrived when the award of the prize might well be discontinued. No offer of the prize was therefore made for the past year.

XI.—Examinations in Practical Music.

In consequence of the success of these examinations, which were held for the first time in 1879, it was thought desirable that there should be two examinations in London during the year, instead of only one, and it was determined that they should take place in January and in July. For the January examination, 75 candidates entered, 72 presenting themselves for examination, some of whom were examined in singing as well as in playing. 42 certificates of the first-class were awarded, and 33 of the second. 59 of these candidates were students of the pianoforte, 4 of the organ, and 2 of the violin; and there were 23 vocalists. 4 candidates entered for honours, of whom 2 took first-class certificates and 1 a second-class. It is worth noticing that 2 of the candidates for the general examination were awarded full marks by the examiners. Dr. Hullah, the Society's examiner, expresses in his report a very favourable opinion upon the results of these practical examinations as a continuation of the theoretical examinations in the theory of music started by the Society of Arts in 1859. Dr. Hullah also remarks that in the period of twenty years during which these examinations have been held, there has been "an amount of progress in execution, style, ear, reading, and general musical culture, no parallel to which, in the same space of time, has been presented in any other age or country." A practical examination in music has also been held at Glasgow under the supervision of the Society.

The second examination for the current year will be held at the Society's House during the week commencing Monday, the 4th July. For this a larger number of candidates have entered than at any previous examination.

XII.—Musical Education Committee.

This committee, which was appointed the year before last, and whose first report was referred to in the last annual report of the Council, have been continuing their labours. They have issued two short reports dealing with the system under which music is now taught in elementary schools, and also with the proposals at present under cor for the establishment of a college of mu: nection with the Training School for Mus Kensington. The first of these reports, second report actually published by the has appeared in the *Society of Arts Jou* committee's third report can be obtaine chase at the Society's office.

XIII.—National Training School f

In November last, a statement was H.R.H. the Duke of Edinburgh, as Pr the Committee of Management of t reminding the founders of scholarship period of five years, for which the s originally established, would expire a 1881. This statement held out the ho permanent school of music, under the ma and control of the State (as originally de the Society of Arts), might, at no remo be established; but it also stated that th tions which the committee of manag the school were carrying on, were stil gress, and that however favourably th terminate, it would not be possible to i such a new institution by Easter last. mittee, therefore, appealed to the foun they should renew the scholarships for from Easter 1881 to Easter 1882. The a was addressed to the Society as having four scholarships at the school. The m fully considered by the Council, and eve was determined that a sum of £160, the of the annual amount granted by the S the establishment of its four scholarshi be placed at the disposal of the National School for Music towards the maintenan school. In making this grant, the Cour to the committee of the school to decid manner the money should be employed in founding fresh scholarships, continuin or in any other way which might seem to the committee.

The two scholarships provided by sub from members of the Society and others renewed for one year, one of the subscr W. Atkinson, having very liberally inc amount he formerly gave, in order to e the full sum of £80 should be forthcomi

The grant of £160 made by the Society stated, has been used by the committee o ment of the school to endow four sch which have been awarded as follows:- Bénard, pianist; F. W. Crooke, violini Synyer, pianist; and Florence M. pianist.

The two scholarships subscribed for by and others have been awarded to Mon pianist, and Alice Menzies, pianist.

The actual result of the appeal of the was the endowment of 82 scholarships f and the committee have also received for general purposes, amounting to besides the £160 grant from the Society, committee have disposed of, as above-m in founding scholarships. Dr. Sulliv retired from the Principalship, Dr. St late Vice-Principal, has been appointed and Dr. Sullivan has been placed on mittee of Management of the school.

school has been recently examined by a of examiners appointed by H.R.H. the e of Wales, and consisting of Sir Michael , Sir Julius Benedict, Sir George Elvey, Dr. Hullah, Otto Goldschmidt, Esq., W. S. s, Esq., and Henry Leslie, Esq. The report se gentlemen, after dealing fully with details, udes as follows:—(The examiners) "consider the school has done and is doing much good . It would be a national misfortune if it did continue its operations. The examiners hope those occupying the leading position in its ion will spare no efforts to secure that great *ratum*, a Musical and Dramatic Conserva- m, which shall be the central home for all is most talented and artistic in Great Britain ts dependencies."

is satisfactory to be able to state, that twenty- of the scholars left the school last Easter, to upon the active duties of the profession for h they had been preparing themselves at the l. Most of these, it is reported, have ob- d good positions, some as public singers or rs, some as organists and choirmasters, and as teachers.

XIV.—Patent-law.

the address delivered by Mr. Bramwell, as man of the Council, at the opening of the on, special attention was drawn to the subject he improvement of the Patent-law. The cil have had under consideration the best the Society of Arts could take in order to about the much-needed improvements in the and they came to the conclusion that the most plan to pursue would be to draft a Bill, which d be, so far as the powers of those engaged it could make it, a perfect measure, whether it might be possible eventually to pass all its ions into law. The Council appointed a com- to prepare this Bill. The Committee has met ntly and has given much thought and atten- the subject. The Council would have been f it had been possible to have presented their Bill to the members before the conclusion of ssion; but the work, as might be expected, l too great for this to be done, and, though ftsman is now engaged upon the Bill, under structions of the committee, it has not been possible to get it so far advanced as to t it before the present time. So soon as the of the committee and the Council is fairly ete, the Council propose to bring their before a meeting of the Society, specially oned to consider it. After it has been fully sed by such a meeting, it will then be recon- d by the Council and their committee, and res will be taken to get it introduced into House of Commons for the next Parliamentary n. The Council think it wiser to defer, until can bring the whole matter forward in a ete shape, any statement as to the principal ions which are being introduced into the they can only say that the committee has careful attention to all the suggestions h have been made by various bodies for improvement of the law, and that they to produce a measure which will, so far t is possible, give satisfaction to those tent to form an *opinion upon it*. The Council consider this to be one of the most important pieces of work which they have undertaken for some time, and they think that if, before the next Session of Parliament begins, they can bring forward a thoroughly good and practical measure for the reform of the Patent-laws, that the year in which this has been effected will not have been a barren one, so far as the Council's labours are concerned.

XV.—Art Furniture Exhibition.

It may be remembered, that some years ago, a series of Art-Workmanship Exhibitions was held by the Society of Arts. The movement commenced in 1862, towards the end of which year an application was made by the Society of Wood-carvers, asking the Society of Arts to assist them in holding an Exhibition of Wood-carving. The application was agreed to; the Society of Arts made a grant of £30 and a silver medal, the Wood-carvers' Society promising £15. The Exhibition was held in the latter part of the Session of 1863, and prizes were awarded in three classes for wood-carving. In the following year, it was determined to extend the scope of the Exhibition, and prizes were offered to workmen in ten different classes. For the competition seventy works were submitted, and prizes were awarded in nearly all the classes. For the following year — 1864 — the Council offered prizes amounting to upwards of £500. The works were arranged in two divisions—1. Works to be executed from prescribed designs; and, 2. Works to be executed without prescribed designs. In the first division there were 18 classes. The second division comprised three classes of wood-carving. In response to this offer, 87 works were sent in, and prizes to the extent of £274 were awarded among 37 competitors. The Exhibition of these works was held at Christmas, 1864. Previous to holding the next year's competition, a meeting of workmen was held, the scale was extended, and the amount of prizes increased to £600. As before, the works were arranged in two divisions, according as they were executed from designs or without designs. The classes in the first division were identical with those of the previous year, a class being added, however, for illuminations. The competition in 1866 does not seem to have differed materially from those of former years. From this year, up to 1871, the competitions were continued in much the same manner; but when the first of the series of Annual International Exhibitions was held, it was considered that they would, to some extent, occupy the place of the Exhibitions of Art-Workmanship, and, therefore, the movement was brought to an end.

Last autumn a proposal was submitted that these Exhibitions should be revived, and that medals and certificates should be offered to workmen who had designed or shared in the construction of objects of art-workmanship. The proposal was approved, and a committee was appointed to carry it into effect. The Council of the Royal Albert Hall undertook to provide space, and to assist in other ways. On further consideration, it appeared desirable that the Exhibition should be restricted to furniture alone, instead of embracing all kinds of Art-manufactures, as was the case with those formerly held, and, accordingly, arrangements were made with the following firms, by which

each firm undertook to fill a certain share of the available space:—J. G. Crace and Son; Morant, Boyd, and Blanford; Jackson and Graham; Gillow and Co.; Holland and Sons; Howard and Sons; Wright and Mansfield; Collinson and Lock; Gregory and Co.; Shoolbred and Co.; Johnstone, Jeanes, and Co. All these firms readily accepted the regulation that the prizes should be awarded not to the actual exhibitors, but to the workmen; and they undertook to assist the judges in making their awards. It was also understood that these firms would afford facilities to exhibitors of articles which might be considered as accessories of furniture, such articles being shown in company with the specimens of art furniture exhibited. Besides these, several other manufacturers of furniture, and of accessories of furniture, are showing specimens of their productions.

Without any exception, the firms above mentioned took up the matter most cordially, and the result is a most interesting and attractive collection of high-class modern furniture. All who have visited the Exhibition, speak of it in warm terms of commendation, and the Council hope that it may be the forerunner of others of equal interest in future years. Members of the Society have the right of free admission by ticket. The exhibition will remain open till the end of July, or till some time in August.

The award of medals and certificates to the workmen employed in the manufacture of the exhibits has not yet been made, but a committee has been appointed, and they have now the matter in hand.

XVI.—Memorial Tablets.

During the past Session tablets have been erected on six houses to mark the residences of the following celebrated men:—

James Barry—36, Castle-street, Oxford-street.
William Hogarth—30, Leicester-square.
[This house has been rebuilt for Archbishop Tenison's School.]
Sir Isaac Newton—35, St. Martin's-street.
Peter the Great—15, Buckingham-street, Strand.
Richard Brinsley Sheridan—14, Savile-row.
Sir Robert Walpole—5, Arlington-street.

In former years the Society of Arts has placed these memorial tablets on houses inhabited by Burke, Byron, Canning, Dryden, Faraday, Flaxman, Franklin, Garrick, Handel, Johnson, Napoleon III., Nelson, Reynolds, and Mrs. Siddons.

The Council have under consideration a list of houses on which such tablets might properly be put, and they would be glad to receive any information or suggestions which might assist them in selecting other suitable buildings.

XVII.—Arsenical Colours.

The committee, whose appointment was mentioned in last year's report, have, during the past Session, appointed a sub-committee, which carried on a careful series of investigations in order to lay down precise, and, if possible, simple instructions for testing the existence of a harmful amount of arsenic in coloured fabrics and paper. The sub-committee have prepared instructions, and have reported through the General Commtitee to the Council. The report has only just been and in a matter of so much importance it has been thought better not to publis it has received the full consideration it on the part of the Council. The Co that the thanks of the Society are du members of the whole committee, who h constant attention to the matter, and mo ally to the members of the sub-commi Heisch and Dr. Bartlett, who carried o vestigations, and gave to them a great de valuable time.

XVIII.—Barry's Pictures.

The well-known pictures by Barr Society's Great Room, being in a condition, it was determined last year should be cleaned. They underwent cess successfully during the summer their appearance was much improved by pictures have now been in the Society's for nearly one hundred years, the fi exhibition of them having been made in appears from the Society's records, they cleaned three times previous to the cle received last year, namely, about 1834, i in 1863. The cleaning which they und year was as slight as possible, the pictu only been washed over, and nothing h done which would in the least degree surface. The work was skilfully pe Mr. Andrew, of the South Kensingto Forming, as these paintings do, almost monument of the genius of a very artist, they deserve the greatest care th bestowed upon them, and it is satisf able to report that they are in good co likely to remain so for many years to the same time as the pictures were decorations of the Room were cleane walls painted.

XIX.—Inland Telegrams

It was stated in the last annual repo Council had addressed a memorial t master-General, asking him to reduc for inland telegrams. In July last a from the Council waited on Mr. Fawce the advantage of hearing from him portant statement as to the views of the Government upon the question of tariff. It appeared, from what M said, that in the opinion of the there could be little doubt that a r the tariff would involve, at all event rary reduction in the revenue, and the gathered that as soon as the Chance Exchequer was in a position to face suc tion in the revenue, there was a reaso that the charges for inland telegram lowered. A full report of Mr. Fawcet as well as of the observations made by Chadwick and by other members of the appeared in the *Journal* for July 23rd,

XX.—Sydney International Exh

The Commissioners for the Sydney In Exhibition have been good enough to the Society of Arts a gold medal a loma, in recognition of the assistan

Exhibition by the loan of Barry's paint- The Temptation of Adam," and also in ition of the gift of engravings and etchings ry, which the Society presented to the Art ' of New South Wales, after they had been ed at the Sydney Exhibition.

XXI.—Owen Jones Prizes.

e prizes are awarded on the results of the competition of the Science and Art Depart- o students of Schools of Art, for designs for re, carpets, &c., on the principles laid down en Jones.

prizes were offered for competition in the ; year, each prize consisting of a bound f Owen Jones's "Principles of Design," and ze Medal.

successful candidates were—J. W. Riley of Art, Halifax; G. Potter, School of Art, : Fanny Buckfield, School of Art, mpton; Lucie Shepherd, School of Art, mpton; James Henderson, School of Art, ı; Thomas Smith, School of Art, Coal- ale.

XXII.—Plant Label.

e end of last year, Mr. G. F. Wilson, F.R.S., ed the Council of the Society to undertake ard of a prize of £5, which he placed at their l, for the best label for plants. The object offer was to obtain a cheap and durable nd thus to supply a want much felt by lturists. The Council accepted the duty, led to Mr. Wilson's offer, a Society's silver In answer to an announcement made to ect, 120 sets of labels were sent in by the ted day, namely, the 1st of May last. are now under the consideration of a com- which it is expected will soon be able to as to their merits.

XXIII.—House Sanitation.

anuary last, the Council published an offer ee Silver Medals, for the best sanitary ements in houses within the metropolitan The medals were offered to the occupiers, or owners of the houses. One medal was warded for a house let out in tenements to s, for which a weekly rental is paid; one ouse of a yearly rental of from £40 or less); and one for a house of the yearly rental) and upwards. In answer to the offer, six submitted their houses in competition, and ard of the prizes is now under the con- ion of a committee of judges appointed by incil.

.—Sanitary Arrangements of Society's House.

ras thought desirable to examine into the on of the drains of the house, and the ation revealed so defective a state of things was determined to amend the system. This ne by Mr. E. Griffiths, under the supervision . Robert Rawlinson, C.B., on the most ap- . principles, and at an expense, on the whole, 8, this sum also covering the cost of a new y, which has been arranged for the con- ce of members. A room on the ground floor, ie library, has been devoted to this purpose. Messrs. Doulton were good enough to present the Society with all the necessary fittings.

XXV.—Domestic Economy.

A Congress for the purpose of promoting the teaching of Domestic Economy in Elementary Schools has been held in connection with the Society. An Executive Committee was appointed by the Council, and by their assistance an influential committee of ladies was formed, under the presidency of H.R.H. Princess Christian. This committee divided itself into sub-committees, each sub-committee dealing with one of the divisions of the subject according to the classification adopted by the Education Department.

The Congress was opened on the 20th June, by a *Conversazione* in the Royal Albert Hall, which was largely attended. The meetings for the reading and discussion of papers were held in the Rooms of the Society and in the Albert Hall, on the following days of the week. The subjects discussed included "Methods of Teaching and Examining Domestic Economy," "Needlework," "Food and Cookery," "The Dwelling," "Health," and "Thrift." As many as 56 papers were contributed under these different heads.

The following report of the Executive Committee has been received by the Council:—

1. The Executive Committee, at the last meeting of th Congress, presided over by the Countess of Derby, have the pleasure of reporting to the Council of the Society of Arts that the hopes of success entertained when the Council sanctioned the holding of a Congress of Domestic Economy in London have been fully realised.

2. The Congress was opened at the Royal Albert Hall on Monday evening, 20th June, and attracted a company numbering more than five thousand persons, the majority of whom were members of the Society. The opening was made interesting by the lighting up of the Conservatory of the Royal Horticultural Society by several systems of electricity; by the agreeable singing of children trained on the Tonic Sol-fa method; by the effective singing of the students of St. Mark's College, Chelsea; of the vocal and instrumental performances of the students of the National Training School of Music; by the playing of the bands of the Military Asylum, Chelsea, and of the Coldstream Guards.

3. The reading of papers and discussions during the Congress have been able and practical, and have been carried on daily during the week, under the presidencies of the Countess of Airlie, the Duchess of Leeds, the Countess Spencer, the Viscountess Strangford, the Dowager Lady Stanley of Alderley, Lady Reay, and Mrs. Dacre Craven, ladies most experienced and accomplished for the purpose.

4. Her Royal Highness the Princess Christian of Schleswig Holstein presided at the delivery of Mrs. Buckton's lecture, and cordially expressed the knowledge and gratification she had derived from hearing it.

5. The success of this Congress is entirely due to the great and sympathetic interest which women, rather than men, have taken in it. Very few important female minds, thoughtful on women's home duties, and knowing how to teach them, have been absent.

6. The success shadows the likelihood of that forthcoming change in the Education Code, which the Congress has advocated; and confidence may be expressed that public opinion will support the Education Department in realising such necessary change.

7. Reports of the papers and discussions have been published daily, and they will be collected together hereafter. The Executive Committee recommend that some very able papers having much scientific interest, but not especially appropriate to the teaching of Domestic Economy in Elementary Schools, should be published in Society's *Journal*.

8. Before the conclusion of the Congress, strong convictions were expressed by the members unanimously, that this

Congress was only the beginning of a movement for connecting the knowledge of home duties with the earliest teaching of children by women, and securing that reform of the Education Code which has been announced by the Lord President and Vice-President of the Lords of the Committee of Council on Education.

9. Accordingly, a very satisfactory beginning has been made to collect funds for preventing interruption to the work of the Congress, and for holding another Congress in 1882, when it is hoped that the plan of a National Institution, with local branches throughout the United Kingdom, may be matured and submitted to the Congress for approval. The Executive Committee have the great satisfaction of reporting that her Royal Highness the Princess Christian has expressed her gladness at continuing at the head of this movement, which is of the very highest national importance to all subjects of the Queen.

XXVI.—Education Committee.

In May last, on the motion of Mr. Edwin Chadwick, the Council appointed a committee to consider the question of the Education Code, and to suggest any measures of reform which, in their opinion, it might be desirable to bring under the notice of the Education Department. The committee has met once, but it has not yet reported to the Council. It is now some time since the Council have appointed an Education Committee, but reference to the back numbers of the *Journal* will show that, some years ago, when such a committee existed, it was the means of bringing before the Society much useful information on national education and kindred subjects.

XXVII.—Food Committee.

It will be in the knowledge of the members that there has long been a standing committee of the Council for the purpose of treating matters relating to the food supply of the country. The committee was formed in 1867, and for some years after its formation published the results of a number of elaborate inquiries and examinations made by its members. The committee also took a large amount of evidence on the subject of food supplies and distribution, which also was published in the Society's *Journal*. The committee have also had at their disposal now for many years a prize of £100, presented to the Society by the late Sir Walter Trevelyan, for the best method of preserving fresh meat. Though numerous methods, more or less successful, for treating meat have been before the committee, the committee have never felt themselves able to select any one as being so far superior to the rest as to deserve the award of the prize, neither have they had from any of those persons who are now engaged in the importation of meat preserved by means of cold from America or Australia any such precise claim to the credit of the invention as would warrant the committee in thus awarding the prize. The prize, therefore, still remains in the charge of the Society, and the Council would gladly welcome the advent of any process which would justify them in presenting it.

With a view of further considering this important subject, the Council have recently re-organised and enlarged the Food Committee. They have secured the assistance of a large number of gentlemen specially conversant with the subject, who will act as a General Committee, and this committee has divided itself into seven sub-committees, which will deal with the following divisi[on] subject:—

1. Fresh Animal and Vegetable Produ[cts] and Foreign.
2. Preserved Animal and Vegetable [P] Home and Foreign.
3. Fish—fresh or preserved.
4. Drinks of all kinds.
5. Cookery.
6. Scientific questions affecting the co[m] adulteration, preparation, methods of pre[servation] nutritive and dietetic value, &c., of vari[ous] of food.
7. Matters affecting importation, cu[stoms] excise, revenue rates, &c., of food.

It is proposed to hold a general meet[ing] year, at which the actual condition of th[e] may be considered, and the Council are able to announce that Professor H[uxley] undertaken to preside at the meeting in in the meantime, to act as chairman of mittee. The sub-committees will, it is able at this meeting each to bring up its own division of the subject, and t[hey] trust that by thus calling public atten[tion] matter, they may be doing useful direction in which the Society has, since tion, so frequently laboured.

XXVIII.—Copyright.

The Society for the Amendment of have had for some time in hand a [B] improvement of the law of copyright drafted the Bill, they applied to vari[ous] tions for assistance in providing a fu[nd] the necessary expenses. Inasmuch as right is a subject with which this Socie[ty] been associated, the existing Act on t[he] having been passed through the agen[cy] Society of Arts, the Council felt justified in contributing ten guineas to

XXIX.—Obituary.

During the past year many notable m[en] been removed from the Society's list of Obituary notices of all the following hav[e] in the pages of the *Journal*, so it must merely to recapitulate the fact of their l[oss].

The first on our obituary list for t[he] Session was the Rev. Arthur Rigg. Fe[w] of the Society took a more active int[erest] welfare than Mr. Rigg, and few were to render it assistance. He gave the So[ciety] courses of Cantor lectures, and also wr[ote] and reports for it. As a pioneer in t[he] technical education, Mr. Rigg's name deserve to be remembered in this cou[ntry]. G. Yapp died in November, and in him lost a useful correspondent, and the S who had often taken an active share i[n] its work, especially in such as related tions. Frank Buckland was not a mem[ber of the] Society of Arts, but he was well kn[own] and had frequently assisted in its w[ork]. first Juvenile Lectures of the Soc[iety were] given by Mr. Buckland, and he, o[n other] occasions, read papers here, and other[wise took] part in our labours. Mr. Mechi w[as an old] and valued member of the Society, and h[e served] both on the Council and on various co[mmittees]

bours for the promotion of scientific agri-re are well known, and the Council are glad rn that, though Mr. Mechi left but a small sion for his wife and family, this is now being emented by liberal subscriptions. Dr. Sten-, who died at an advanced age in December, nother member of the Society well-known in scientific world. He, too, had read papers Mr. William Arnot died rather suddenly, indeed, only a little while before his death me had been put down for the reading of a on his own special subject, the manufacture per. The members will recollect the excellent of Cantor lectures which was delivered be-the Society in 1877 by Mr. Arnot. Professor nt was a very old member of the Society, and valued member. He was a frequent attend-our meetings, and was at all times ready to whenever his special knowledge or the col-which he had formed were likely to be of to the Society. The Earl of Caithness, who March, had been a member of the Society 1851, and at one time had been vice-presi-Lord Caithness then took an active in-in the Society's work. The last time of endance at a meeting was when Professor ead his first paper on the Telephone here, ich occasion Lord Caithness was the first to he actual working of the instruments, which eparated by the distance, then thought re-ble, of over a mile, between the Society's and the printing office in Fleet-street.

XXX.—The New Council.

four senior vice-presidents, who were com-to retire this year under the bye-law which tes the constitution of the Council, were Granville, Lord Northbrook, Sir John ck, and Mr. Edwin Chadwick, all of whom in different ways and on different occasions, red valuable service to the Society. The amed, Mr. Edwin Chadwick, has, as the ers are well aware, been the main promoter ny schemes which have been brought for-through the agency of the Society. In their the Council now put forward for election the of Buccleuch, one of the oldest members of ociety, since he was elected in 1838; the Duke arlborough; Sir Richard Temple, whose able on "Forest Conservancy in India," ted so much attention when read in the n Section last year; and Dr. Richardson, who ne of the retiring members of the Council. Dr. Richardson, Mr. G. C. T. Bartley, Mr. nell Carter, Mr. Henry Doulton, and Rear-al Mayne, were removed from the list, either niority or by least attendance. In their place ouncil now propose for election, Lord Alfred hill, who has been off the Council for a year, hose name the Council feel sure the members gladly see restored once more to its proper in the list; Mr. George Matthey, F.R.S., minent metallurgist; Admiral Sir Edward eld, C.B., F.R.S., who served once before on ociety's Council; Dr. E. Frankland, the dis-ished chemist; and Mr. Loftus Perkins, who known for his investigations in high pres-team-engines.

XXXI.—List of Members.

re can hardly be any better sign of prosperity than an increase in the list of the Society's mem-bers, and it is satisfactory to be able to state that such an increase has occurred during the past year. During the year 1880-81, 323 members have been removed from our list by death or resigna-tion. During the same period 370 have been elected. There is, in consequence, an increase of 47. The total number of life and subscribing mem-bers is 3,302. There are also 37 institutions which subscribe to the Society from their own funds. This makes a total of 3,339.

XXXII.—Finance.

In accordance with the Society's bye-laws, the annual statement of receipts, payments, and expenditure for the past year was published in last week's *Journal*, in order to give members the opportunity of informing themselves as to the state of the Society's finances before attending the Annual General Meeting. An examination of this statement will show that the finances of the Society are in a thoroughly sound condition, and that the Society is as flourishing as ever it was. It was stated in last year's report that earnest efforts had been made during the year then passed to pay off a certain amount of floating debt, which had been in existence for many years. This was done, and the finances having once been placed on this satis-factory footing, it now only remains to keep them in the same condition, by a careful watch over the various items of expenditure, and by equal care as regards the sources of revenue of the Society.

It may now be well to glance through the various items of the financial statement. Beginning with the debtor side, we find that the amount of subscriptions received during the year was £6,005 10s., and it is not a little remarkable that this item almost exactly coincides with the similar item of last year, £6,005 8s., there being only a dif-ference of two shillings. The amount of life com-positions last year was very high. It was £567. This year, however, it has been exceeded, for we have had £609 contributed in this way. The total receipts from subscriptions during the year are, therefore, just £42 more than they were last. Although this difference is slight, it is gratifying to see that the difference is one of increase. The amount received by the Society's dividends and interest is a little larger this year than last—£647 against £626. This is due to the additional investments which have been made by funding the life subscrip-tions. The next item on this side of the account which calls for remark is the advertisements. Here we are compelled to acknowledge a falling off, the receipts having been £1,457 in 1881, against £1,604 in 1880. This must be attributed to the rather stagnant condition of trade of late years, and it is to be hoped that this item of revenue will soon re-cover itself. The receipts from sales are about the same as last year. They include the proceeds of the sale of some of Barry's etchings. Some sets of these interesting pictures still remain in the Society's possession, and they can be sold to members at the cost of ten guineas. In this year's state-ment the Society has not to account for any funds which, as frequently happens, have been entrusted to it for distribution. There is, therefore, no item like the £100 received from Mr. Watherston last year, for his prize on silversmith's work. The total receipts of the year 1881 are £9,485; those for last year

were £9,744; the difference being due to the falling off in the advertisement receipts, and to the fact that in last year's account the £100 Watherston prize above referred to appeared.

We may now turn to the credit side. Taking the items in the order set down, we find, under the first head, "House and Premises," a heavy charge for the alterations in the drainage, and for the new lavatory. This brings the total amount under this head up to £459; the corresponding head for repairs and alterations last year was £166, so that it will be seen there have been paid during the present year £338 more under this head. Although this is a heavy charge, it was a necessary one. Some particulars about it are given in the body of the Report. The item "Salaries and Wages" for the present year, is £47 heavier than last. This excess is due to a necessary addition to the clerical staff of the establishment. The charge for cleaning Barry's pictures appearing in the present statement is, of course, a special charge for this year only. The charge for stationery, printing, &c., is £53 less this year, but this is merely due to arrears of payment having been made up during 1880. The same reason accounts for the *Journal* having cost £426 more in 1880 than 1881, the total cost of this important part of the Society's operations being £2,016 this year. The charge for advertisements is £92 less this year, as was of course to be expected from the receipts from the same source being less. The examination charges show a considerable reduction this year, for they were £187 more in 1880 than in the present year. This of course is due to the alteration in the system of examinations. The Conference on Public Health, held in 1880, the payments for which were made during the financial year just ended, cost the Society £105, the similar Conference the previous year cost the Society £258, so here we find a reduction of £153. For the Domestic Economy Congress, just held, £73 have been paid; the remaining expenses for this will appear in next year's financial statement. The item for the Albert Medal deserves a word of explanation. It happens that the medal for the year before last, as well as for last year, was paid for during the past financial year, the presentation of both of them having been made by H.R.H. the President at the same time. Under the head of prizes, we find last year the Swiney Prize of £100, and Mr. Watherston's prize, also £100. There is, therefore, a difference of nearly £?00, actually £195, in consequence of the new Prize for House Sanitation, on which some small expenses have been incurred. The amount spent on Cantor lectures this year is £10 less than that spent last. These charges are defrayed, as the members are aware, out of funds left by Dr. Cantor to the Society. The National Training School for Music again appears for the sum of £164, but it is not expected that any charge under this head will recur. The Art-Workmanship Exhibition is down for the small charge of £5. The principal charges for this will appear next year; it is not supposed that they will exceed some £50. In last year's statement, we find a sum of £196 put down for payments on account of the Artisan Reports on the Paris Exhibition of 1878. This being the last payment in this matter, there is, of course no corresponding item in the present year's statement. The total amount expended by the Society was £8,716; the amount last
£9,297. It will thus be seen that in th
year there has been expended £581 less
year.

We now proceed to consider the a
liabilities of the Society. Here, again,
very satisfactory state of things. The
assets over liabilities last year was £7,73
present it is £8,617, showing a differen
good of £882. Amongst the liabilities, t
men's bills, due at the present time, are
than last year. The alteration in the ex
system has reduced the amount du
Examiners from £188 in 1880 to £54 in
difference being £134, while the £42 se
liabilities for two medals in the 1880
have been paid, and therefore no liabil
at present under this head. As to th
assets, our invested funds have been
from £3,571 in 1880, to £4,344. The su
of the year uncollected are £61 less
year—£749 against £810; while it is
sign, also, to note that the arrea
quite so heavy, and may be es
£300, instead of £350. The prope
Society is put down at the moderate
£2,000. The same cause which has r
actual earnings for the *Journal* adv
during the year has also lowered the
down as an asset under this head. W
£1,256 which we may expect to obt
£1,477 last year. The Trust Funds in
of the Society are set out at length in
ment. The principal of these is D
bequest, £5,052, the interest of which
to the popular Cantor lectures.
in amount is the bequest of D
£4,500. This is chargeable with t
£200 once in five years, £100 of w
pended upon a silver goblet, and the
presented with the goblet to the autho
published work on Jurisprudence. Al
bequest is £1,800. The income of th
applied for the general purposes of t
The following Trust Funds are charges
award of medals or money prizes out of
resulting from them:—

John Stock	....
Benjamin Shaw	....
North London Exhibition	....
Fothergill	....
Dr. Aldridge	....
Thomas Howard	....
Owen Jones Memorial	....

The Mulready Trust of £109 is charg
expense of preserving in order the to
artist in Kensal-green Cemetery. Th
subscriptions for the Memorial Wind
Paul's Cathedral, £345, is being he
Council until some decision on the s
been arrived at. The amount of £100,
prize by the late Sir Walter Trevelyan
above in the section of the report dealin
Food Committee, has been placed on de
Messrs. Coutts. There is also an amou
subscriptions to an endowment fund, a
of £50 given by Mr. Murray as a nuc
building fund.

irman, in moving the adoption of the report, some of the chief points contained in it. He the award of the medal to Dr. Hofmann e the greatest satisfaction both in Europe nerica. As to the Patent Bill, now being could not say that they would be able but it would go forth as a Bill which the ught ought to be passed. He must acknow- e was horrified at the particulars which were he meetings of the Committee on Poisonous here he learned that the green of the ordinary inds was often obtained by the use of arsenic nt, and that, after having been dried by ese blinds threw off a considerable amount l dust to poison the air of the room. He the members present, with regard to the the walls, that no mother washed her ith greater care than was taken by those ook the responsibility of cleansing Barry's He then made a few remarks upon the reduc- price of telegrams, upon house sanitation; g to the Food Committee, of which Professor consented to act as chairman, said that any which that gentleman was connected was good work. In conclusion, he expressed the the details given under the head of finance, the items of receipts and expenditure in- many who found some difficulty in understanding a balance-sheet.

S. Rumsey seconded the adoption of the

pin objected to the paragraph in the report nt-law, as no notice was taken of previous He thought Mr. Anderson's Bill was satis- l that it would have been better to have hat than to bring in a Bill that was not ss.

objected to the time of meeting, and thought ions should be more fully reported. The ction to the Council needed revision, so that t be a more general selection from among s.

t was then agreed to.

rman declared that the following had been ll the several offices.

e in *italics* are those of members who have the past year, filled the offices to which een elected.

PRESIDENT.

[.R.H. the Prince of Wales, K.G.

VICE-PRESIDENTS.

Duke of Edin- .G.	*Duke of Marlborough, K.G.*
rince Leopold, Albany, K.G.	W. H. Perkin, F.R.S.
, C.B., F.R.S.	Robert Rawlinson, C.B.
rford Alcock,	Lord Reay.
	B. W. Richardson, M.A., M.D., F.R.S.
well, F.R.S.	C. W. Siemens, LL.D., F.R.S.
nas Brassey, M.P.	Earl Spencer, K.G.
ucleuch, K.G.,	William Spottiswoode, LL.D., P.R.S.
Cole, K.C.B.	Right Hon. J. Stansfeld, M.P.
uglas Forsyth, C.B.	Duke of Sutherland, K.G., F.R.S.
uglas Galton, R.S.	*Sir Richard Temple, G.C.S.I., C.I.E., D.C.L.*
ick Leighton,	

ORDINARY MEMBERS OF COUNCIL.

George Birdwood, M.D., C.S.I.	*Admiral Sir Edward Inglefield, C.B., F.R.S.*
Andrew Cassels.	*G. Matthey, F.R.S.*
Lord Alfred S. Churchill.	Admiral Sir F. W. Nicolson, Bart., C.B.
Sir Philip Cunliffe-Owen, K.C.M.G., C.B., C.I.E.	*Loftus Perkins.*
Lieut.-Col. Donnelly, R.E.	W. H. Preece, F.R.S.
Edward Frankland, D.C.L., F.R.S.	Lieut.-Colonel Webber, R.E.

TREASURERS.

B. Francis Cobb. | Owen Roberts, M.A.

SECRETARY.

H. Trueman Wood, B.A.

Mr. Liggins thought the reason why these annual meetings were not more fully attended, was that members were quite satisfied with the conduct by the Council of the Society's business. He then drew attention to Mr. Hyde Clarke's letter in the *Journal* of June 10, on the "Manufactures, Trade, and Progress of England," and suggested the appointment of a committee by the Council on this subject.

Mr. Christopher Cooke referred to the erection of memorial tablets, and suggested some additional houses upon which they might be set up.

Mr Hyde Clarke urged that some action should be taken to preserve the trade which was being wrested from Englishmen by foreigners, and that more attention should be paid to British commerce abroad. He thought a committee appointed by the Council might do much for the improvement of the present state of manufactures.

Mr. Christian Mast supported Mr. Clarke's proposal, which he considered to be one of the greatest importance.

Mr. Pfoundes said that he considered this a most practical proposal; and from his own experience he could say that, if the suggestion was carried out, the members of the Consular service would be greatly helped by such action.

Mr. Pagliardini thought that Mr. Clarke should read a paper on the subject early next Session. He also suggested that a tablet should be erected on the house, No. 20, Bentinck-street, where Gibbon wrote his history.

Mr. Hyde Clarke could not agree with Mr. Pagliardini, as he considered his proposal was one to which immediate attention should be given.

A vote of thanks to the Scrutineers, moved by the **Chairman**, and seconded by **Mr. Rumsey**, was carried unanimously.

A vote of thanks to the President, Vice-Presidents, Council, and Officers (especially to the retiring members of Council and to the Chairman), proposed by **Mr. Hyde Clarke**, seconded by **Mr. Hale**, and supported by **Mr. Campin**, was carried unanimously.

Mr. Bramwell returned thanks, and the meeting adjourned.

MISCELLANEOUS.

NOTES ON GUMS, RESINS, AND WAXES.

By C. G. Warnford Lock.

The following economic notes, from the journals of recent travellers, seem worthy of reproduction in a collective form:—

Senegal Gum.—The product of acacias which grow

in the neighbourhood of the Sahara. During the harmattan winds, the gum exudes from the bark of the trees in tears, and solidifies in the open air, the amount of exudation depending upon the force and duration of the wind. The production in 1871 was 3,161,906 kilo. (of 2·2 lb.).

Mpafu.—A large tree yielding a sweet-scented gum-resin, much valued by the natives on the Victoria Nyanza.

Gum Arabic is produced by *Acacia gummifera* (*Mimosa gummifera*, *Acacia coronillæfolia*, *Mimosa coronillæfolia Sassa gummifera*), a scarcely known plant of Morocco, occurring abundantly as a thorny bush in the lower region of south and west Morocco, according to the testimony of the natives, who call the plant *alk tlah*. The gum does not seem to be collected in the western portion of its range in south Morocco, but in Demnet, whence it is carried to Mogador. Possibly it is only in the hotter and drier regions of the interior that the gum is produced in quantities to be worth gathering. At any rate, its gum is yielded only during the hot, parching months of July and August, and increases according to the hotness of the weather and the sickly appearance of the tree, being least after a wet winter and in a mild summer.

Some accounts suppose the Moroccan gum Arabic to be derived from *Acacia arabica*, which is found in Senegal; but all the inquiries made by Consul R. Drummond Hay, for Hooker and Ball, agree that this plant, the *alk awarwhal* of the Arabs, is not found in Sus, no such tree existing either north or south of the Atlas Mountains, its gum being brought from Soudan, and of inferior quality to that of *A. gummifera*. It is further stated that this latter species grows chiefly in the provinces of Blad Hamar, Rahamma, and Sus.

Elemi.—This used to be brought in large cakes to Bembe (West Africa), and is said to be very abundant at not many days' journey.

Jutahy-seca.—A resin or gum which exudes from the bark of the jutahy tree of Brazil (*Hymenæa mirabilis*); universally employed for varnishing native pottery.

Copal.—Red gum copal is almost entirely the product of the Mossulo country (Angola), though it exists farther north, as at Mangue Grande. Until 1858, it was a principal export from Ambriz to America, but the war stopped it. According to native accounts, it is found below the surface of a highly ferruginous hard clay, at a depth of a few inches to two feet. It probably extends much deeper, but the natives are too lazy to look for it. It occurs in irregular flat masses up to several lbs. The natives only dig for it during and after the last and heaviest rains in March—May, and restrict the export to maintain the price. No trees and but little grass grows over the spots. The tree is said to be abundant in the woods adjoining the inner side of the wilderness in Usambara (East Africa), but does not extend farther inland.

A great staple of the district traversed by the newly-made road from Dar-es-Salaam, through the Wazamaro country, is gum copal, which is found in many parts. This fossil resin seems to exist, even in the richest diggings, only in patches, as though it were produced by isolated trees. The natives appear to work the country nowhere systematically; they sink test-holes, and, on finding traces of the resin, work that part thoroughly. In many places, test-holes have been made and the place abandoned as useless, although not far off a patch has been well worked. The fossil resin, now found underground usually in red sandy soil, is undoubtedly the produce of the same species of tree as still exists in these jungles, and which now yields an inferior sort of resin. The difference between the two products seems to arise from chemical or molecular change effected by time. The copal tree grows throughout the Uzamaro country, and is by no means confined to the sea coast, but is even more abundant inland beyond the first coast-ridge. It is not seen, however,

where the old limestone formation of the [illegible]
its appearance.

Chian Mastic.—The mastic country of Chio[illegible]
flat and stony, with little hills intervening, a[illegible]
rare streams. Rain is destructive of the [illegible]
is rare, but much to be feared. The resin is [illegible]
of *Pistachia lentiscus*. The principal villages [illegible]
in the industry are Calimassia, Saint George [illegible]
Anabato), Nénita, Mesta, and Kalamoti, be[illegible]
there are about a dozen of minor importan[illegible]
mastic occurs in white grains, varying in si[illegible]
pin's head to a pea. The shrubs yielding it [illegible]
the height of a man. It occurs also in A[illegible]
Arabia, but always of inferior quality, though
factory reason has yet been adduced for the
July—August, a great number of incisions
in the stems of the shrubs, and renewed th[illegible]
times. Repeated visits are then made to [illegible]
resin which exudes. A shower of rain d[illegible]
period produces disastrous results, by washin[illegible]
resin. There are four qualities of mastic:-
mastic is composed of large pieces, and is co[illegible]
best by connoisseurs; it is sold chiefly for
seraglios, all Turkish women chewing mast[illegible]
is 120 to 130 piastres, and even more, per [illegible]
grm. (2.) Mastic in large tears is wort[illegible]
piastres ordinarily. (3.) Mastic in small te[illegible]
is worth 70 to 85 piastres, and is used indus[illegible]
Mastic mixed with fragments of leaves and
to make so-called "mastic brandy," the
Turkish liqueur, called *raki*. It is made
mastic in the brandy obtained from dry
distilling the product, and flavouring with
sugar. The best qualities of mastic are
Levant; Europe imports the inferior grade
varnish.

Chian Turpentine.—Afforded by *Pistachi*[illegible]
That which exudes from the shrub is ver[illegible]
aromatic, but the quantity is very limited.

India-rubber (from *Ficus elastica*).—The
the rubber in Assam is conducted under rigi[illegible]
in the case of all trees growing in the tim[illegible]
but cannot be enforced on scattered trees.
wár rubber plantation has an area of 80 [illegible]
The exports from Lakhimpur in 1871 we[illegible]
value £8,340. Immense forests of these tr[illegible]
both banks of the Subansiri river, and on o[illegible]
but the reckless treatment they receive[illegible]
lessees of the forests caused their ruin.
leasing of these forests ceased, but there
or no rubber left in the plains of the Lakhi[illegible]
The tree grows to heights of 15 to 35 feet,
when fit to be tapped, is 18 inches to 6 [illegible]
yield for the first tapping of a tree is 3[illegible]
rubber. It is then allowed to remain [illegible]
three or four years, when another collec[illegible]
but the yield is then much less. It is e[illegible]
the forests of Cachar could yield upwards
of rubber annually. It is stated that th[illegible]
most during the rains.

Of india-rubber, 20,000,000 lbs. are [illegible]
ported from Pará (Brazil), chiefly d[illegible]
Siphonia elastica, but a few other species [illegible]
The utmost yield from each tree is one
wet season, from February to July,
weak, and the tapping is stopped. The tr[illegible]
on the *terra firme* when planted, but
naturally lodge in lowland swamps. Tr[illegible]
planted and cared-for yield well in fi[illegible]
Brazil is being gradually cleared of
gatherers now go to the Tocantins, Madeira
Rio Negro, and will soon clear there als[illegible]
method of preparing rubber, instead of [illegible]
drop the milk into alum solution; it is [illegible]
superior, but is not adopted.

India-rubber plants grow on the slo[illegible]
Cameroons mountains (West Africa), but

: know their value. India-rubber trees he River Djour, in the province of Bahr el The natives of the Marutse-Mabunda the Upper Zambesi, trade in india-rubber bes to the west.

lolphia vine is known from Pangani inland to Handei (in Usambara, East Africa), and e rubber is made into balls for export.

creeper, *Landolphia*, grows chiefly on trees and streams in Angola and the Congo. exudes a milky juice when cut or wounded, l not run into a vessel placed to catch it, as uickly as to form a ridge on the wound, its further flow. The blacks collect it by cuts in the bark with a knife, and as the gushes out, it is wiped off continually gers, and smeared on their arms, shoulders, till a thick covering is formed. This is eir bodies and cut into small squares, which l to be boiled in water. From Ambriz the rubber quickly spread south to the River ere considerable quantities are exported.

0 miles of the coast from Liawa and the y (Masasi and Rovuma, East Africa) the nes almost entirely formed of india-rubber ing an abundant supply of fine india-rubber, athered only in a very desultory manner by who gash the plants, and collect the rubber n a liquid form, and dries hard after short the air. Rolled into orange-like balls, it is idi, where what is worth 7 to 8 dols. fetches width of the belt is 15 to 20 miles. On Lake (Central Africa) are one or two kinds h produce caoutchouc of good quality.

has just determined, with accuracy, the yields the best East African india-rubber, ained seeds of the species for introduction It occurs in great abundance along the road from Dar-es-Salaam, in a west-south-ection, for about 100 miles towards the ast Africa, through the Wazamaro country; itly but little affected, except in the imme-bourhood of the villages, by the reckless pping employed. In many parts, a native llect 3 lb. of rubber daily. There are five only one is considered worth tapping.

id Guttas of Borneo and Sulu.—The Kadyans irut neighbours collect a quantity of gutta-ndia-rubber in the surrounding forests. The terwards manufactured into lumps or balls, d to Labuan for sale. The gutta is obtained five species of the genus *Isonandra*, all large The trees are felled and their bark is inged at intervals of two feet, the milky being caught in vessels formed of leaves or lls. The crude juice is hardened into slabs boiling, and is generally adulterated with of scraped bark. Indeed, it is said that the ders, who buy up the gutta from the ould refuse the pure article in preference for ing bark, to which the red colour is mainly

ber in the north-west districts of Borneo is of three species of climbers, known to the *manoongan*, *manoongan putih*, and *manoongan* eir stems have a length of from 52 to 100 iameter rarely exceeding 6 in.; the bark is and coloured grey or reddish-brown. The blong, green, and glossy; the flowers axillary clusters, and are succeeded by , of the size of oranges, and containing seeds eans, each enclosed in a section of apricot-t. These fruits have a delicious flavour, h prized by the natives. The stems of the creepers are also cut down to facilitate the the creamy sap, which is afterwards ito rough balls by the addition of nipa salt.

The fallen gutta trees lie about in all directions in the forest, and the rubber-yielding *Willughbeias* are also gradually, but none the less surely, being exterminated by the collectors in Borneo, as throughout the other islands, and on the Peninsula, where they likewise abound.

It was formerly thought that gutta-percha was the produce of only one species of tree (*Isonandra Gutta*), but that obtained from the Lawas district is formed of the mingled saps of at least five species, the juices of a *Ficus*, and of one or two species of *Artocarpeæ*, being not unfrequently added as adulterants. The Bornean *gutta soosoo*, or india-rubber, again, is the mixed saps of three species of *Willughbeia*, with the milks of two or three other plants surreptitiously introduced to increase the quantity.

The gutta trees are slow to attain maturity, and are difficult to propagate, except from seed. The *Willughbeias*, on the other hand, grow rapidly, and readily lend themselves to both vegetative and seminal methods of propagation; hence these are especially deserving of the attention of the Government of India, where they may reasonably be expected to thrive.

There are, doubtless, yet many thousand tons of rubber and gutta in the Bornean woods, but as the trees are killed by the collectors without any thought of replacing them, the source of supply must recede constantly farther from the markets, and prices will rise in consequence. The demand for india-rubber from Borneo is of quite recent growth, yet in many districts the supply is already practically exhausted.

In Assam, Java, and Australia, rubber is afforded by *Ficus elastica*, which is cultivated for the purpose. There are many milk-yielding species of *Ficus* in the Bornean forests which, with careful experiment, may possibly be made to contribute remunerative quantities. The Malayan representatives of the bread-fruit family also deserve examination, as an excellent indiarubber is derived from *Castilloa elastica*, a South American plant of this order.

Lac.—Secreted by an insect (*Coccus lacca*), on the branches and twigs of certain jungle trees, principally *khusum* (*Schleichera trijuga*), *plas* (*Butea frondosa*), and *bier* (*Zizyphus jujuba*). The lac from the first is more esteemed than that from the others. To some extent, the lac is found occurring, so to speak, spontaneously, and is collected by forest tribes, and brought by them to the fairs and bazaars for sale. Where, however, there is a regular trade in stick-lac, propagation of the insect is steadily carried on by those who wish for a certain and abundant crop. This propagation is effected by tying small twigs, on which are crowded the eggs or larvæ of the insect, to the branches of the above-named species of trees. These larvæ are technically called seed. The larvæ, shortly after sowing, spread themselves over the branches, and, taking up position, secrete around themselves a hard crust of lac, which gradually spreads till it nearly completes the circle round the twig. At the proper season, the twigs are broken off, and on arrival at the factory, are passed between rollers, which admit of any degree of approximation. The lac is thus crushed off, and is separated from the woody portion by screening. It is next placed in large tubs half full of water, and is washed by coolies, who, standing in the tubs, and holding on to a bar above by their hands, stamp and pivot about on the heels and toes, until, after a succession of changes, the resulting liquor comes off clear. The lac having been dried, is placed in long cylindrical bags of cotton cloth of medium texture, and about 10 ft. long and 2 in. in diameter. These bags, when filled, are taken to an apartment where there are a number of open charcoal furnaces. An operator grasps one end of the bag in his left hand, and slowly revolves it in front of the fire; at the same time, an assistant, seated at the other end of the bag, twists it in the opposite direction. The roasting soon melts the lac in the bag, and the twisting

causes it to exude, and drop into troughs placed below, which are often only the leaves of *Agave americana*. When a sufficient quantity in a molten condition is ready in the trough, the operator takes it up in a wooden spoon, and places it on a wooden cylinder, some 8 to 10 inches in diameter, the upper-half of which is covered with brass—in some places the freshly-cut, smooth, cylindrical stem of the plantain is used for this purpose. The stand which supports the cylinder gives it a sloping direction away from the operator. Another assistant, generally a woman, now steps forward with a strip of *agave* in her hands, and with a rapid and dexterous draw of this, the lac is spread at once into a sheet of uniform thickness, which covers the upper portion of the cylinder. The operator now cuts off the upper edge with a pair of scissors, and the sheet is lifted up by the assistant, who waves it about for a moment or two in the air, till it becomes quite crisp. It is then held up to the light, and any impurities, technically "grit," are simply punched out of the brittle sheet by the finger. The sheets are laid one upon another, and, at the end of the day, the tale is taken, and the chief operator is paid accordingly, the assistants receiving fixed wages. The sheets are placed in packing-cases, and when subjected to pressure, break into numerous fragments. In the fresh state, the finest quality has a rich golden lustre.

The dark-red liquor before referred to, as resulting from the washing, is strained, in order to remove all portions of woody fibre and other foreign materials. It is then passed into large vats, where it is allowed to settle; the sediment is subjected to various washings, and at last allowed to settle finally, the supernatant liquor being drawn off. The sediment, when of the proper consistency, is placed in presses, from which it is taken out in the form of hard, dark-purple cakes, with the manufacturer's trade-mark impressed upon them. This constitutes what is known as lac-dye. The dye which is thus separated from the lac by washing is said to be the body of the insect—not a separate secretion.

It might appear that some mechanical arrangement would be more efficacious and economical for washing and separating the lac from the dye, but human labour is so cheap, that this is not the case. The daily pay of the women is 1d. to 1½d.; of the men, 1½d. to 2d. No evil effect on the feet of the stampers is to be observed. The great and sudden oscillations of price in the London market render this trade very risky, and the aniline dyes have well-nigh rung the knell of lac-dye in European industry.

In Assam, a small quantity is produced in the district of Darrang. In some districts, the insect is artificially reared on the *jhuri* tree (*Ficus cordifolia*).

Indian White Wax.—This is produced by the female of the *Ceroplastes ceriferus*, an insect allied to the *Pela* of the Chinese, whose product is so largely used for making candles for the Buddhist temples. The Indian insect deposits its wax in small masses upon the twigs and branches of several trees, but more particularly on the *arjun* (*Terminalia Arjuna*); it does not appear to have ever been propagated, nor has the wild product been collected in quantity. Though an article of undoubted value, it would perhaps scarcely repay expenditure of European time and capital; but the natives might surely render its cultivation a very profitable undertaking. The wax is soluble, or nearly so, in boiling alcohol, also in benzine and ether, but only very slightly in turpentine and carbonic disulphide ($C S_2$). Its composition is $C_{1?} H_{2?} O$. It is found at many widely-distant points throughout Sirguja, and is abundant, and suitably situated for experimental cultivation, on the *arjun* trees growing upon the embankment of the Purulia lake.

The Gum Trade of Somali Land (East Africa).—The gum, or *habak*, always sold in grades, bears the name of *ankobib*. On sifting, it is always found mixed with a
small quantity of other sorts which make wei
balance; these are the *habak euddé* and the *ha*
The incense, or *luban*, sold in grades, takes tl
beïho. The *saphi*, or "triage," is divided
qualities. The 1st, *fasous*; the 2nd, *nagoua*
medjigel. The *saphi*, or "triage," is made in
when the arrivals are not too great, by
children, who are paid about 6d. a day.

The myrrh has but one quality, but it is n
be on the guard against the admixture of f
of the same colour, but more powerful odour,
Arabs call *addi*. It is easy to recognise
which always appears oily.

The *maïdi*, called in Europe "gum elemi,
of incense in large bleached tears. It presen
grades as incense, and buyers aim especially
ing the tears unbroken to heighten the value

The *alet*, or *mourcoud*, is a grey gum
exquisite odour recalling that of ambergris.

The *addi*, or false myrrh, whose odorifero
mixed with the wood of *djirmeh*, has an o
burnt closely resembling that of "seraglio p

The *fallah-fallah* is a resinous bark, which
give off a peculiar odour, under the name of *l*

Statistics of the annual receipts of gums a
at the ports of the Medjourtine coast:—

	I
Bender Ziyâda	
Bender Gâsem	1
Abou Régabé } Bender Baad }	
Borah	
Gandala	
Bender Khor	:
Râs Orbé	
Merâya	
Guersa	
Guesli	
Bender Felik	
Atloûla	
Total	

The bohar is equal to 136 kilo., or, say 8
are about 1,200 tons; this increases to 2,0
good year.

Myrrh reaches two places only—

Bender Gâsem	30 Bo
Borah	3

Haffoûn, in 1877, received 25 bohars.

Magnificent incense-trees, two to three feet
are found on the lofty mountains toward
coast of Somali Land. Mareyeh, an
village, lying over 30 miles west of Cap
has a large export of myrrh and incense.

Obeidh, the capital of Kordofan, is the
large trade in gum, which is collected in tl
the women and children, and taken to the
where it is disposed of to petty itinerant
ultimate dispatch to Europe.

Moroccan Gum Ammoniacum (which must
founded with the Persian product of *Dorem*
cum, or *ushak*), is an object of commerce
and Arabia, where it is employed, as of ol
gating. The plant affording it is called
Arabic, and has been hitherto referred to *Feru*
or *F. tingitana*; but Ball and Hooker consider i
an *Elæoselinum*, probably *E. humile*. Learn
that this plant grows at a place two days from
on the Morocco road; but Hooker and Ball w
that it is found nowhere along that route, no
it than El Araiche, a place lying north of M
which is confirmed by information gathe
Drummond Hay, to the effect that it o
Morocco, and chiefly around Tedla.

Gum Sandarach is a product of *Callitris* q
(*Thuja articulata*, *Frenela Fontanesii*), a tree i

mountains of North Africa, from the Atlantic to Algeria, its eastern limit being undertermined. esin, once a reputed medicine, is collected by the , and exported from Mogador to Europe, where sed in varnish-making.

horbium gum is produced by *Euphorbia resinifera*, confined to the interior of Morocco. The juice from incisions made with a knife, and hardens drops off in September, the produce being lant only once in four years. The people who collect m tie cloths over their mouths and nostrils, to le the small dusty particles, which provoke intense ng. The gum once had a wide medicinal use, but ade in it is now rapidly declining, and its con- tion is restricted to veterinary practice, and as an lient in a marine paint.

ASTOR OIL GAS-WORKS AT JEYPORE.

eport by Major S. S. Jacob, on the Jeypore Oil rorks, an establishment founded by the late rajah of Jeypore, is quoted in the *Journal of Gas ing*. From the memorandum on the working of tablishment prepared by the present manager (Mr. Tellery), whose administration is highly com- d by Major Jacob, it appears that the gas is pally produced from castor oil, with the addition, the castor seed is not available, of poppy, til, or seed. According to Mr. Tellery's own records, he ces from one maund of castor oil (82 lbs.) about 750 feet of 26½-candle gas; or 1,000 cubic feet of 18½- gas; or 1,250 cubic feet of 9-candle gas. With oils the same quantity of material worked to make equal qualities will produce 610 cubic feet, 762 feet, and 914 cubic feet of the respective grades minating power. According to these results, taking rrent prices of oils delivered into the works—castor ing Rs. 11 12a. (22s. 4d.), and the other oils Rs. 10 10d.) per maund—the castor oil gas is Rs. 0 10a. 4p. d.) per 1,000 cubic feet cheaper than other oil gas. rorks are double in all respects, duplicate sets of s, purifiers, &c., and gasholders being erected, for arrangement no reason is given. At present two ontal retorts are used, which are kept at work about 218 hours per month, and produce some- like 98,720 feet of gas in this time. Worked in ray, the cost of manufacture (exclusive of the cost) is as follows:—

	Rs.	a.	p.
Wear and tear..........	1	3	2¼
Fuel	2	11	7
Labour	0	5	3½
Purification	0	0	4¼
Total cost per 1,000 cubic feet ...... = Rs.	4	4	4¾, or 8s. 6d.

igh charge for manufacturing expenses is said to to the fact of so little gas being required; if the mption should increase to about 260,000 cubic feet onth, which could be supplied without increased r establishment charges, the working expenses per cubic feet would be reduced to Rs. 2 9a. 5¾p. (5s. 1d.). gas is chiefly consumed in the public offices and s; there are, however, a few private consumers, are charged by meter at the average cost price, 18 1a. 8p. (35s. 10d.) per 1,000 cubic feet, and r well satisfied with the supply. Most of the rs in use consume only 1½ cubic feet of gas per which, with this rate of consumption, is equal to 17 to 18 candles; the gas is therefore of high ncy. The street main from the works is 5 inches meter, which is considered ample for supplying lights. One house in Jeypore has 118 lights led through an inch service-pipe. The loss by ge is estimated at about 13 per cent. The supply of premises temporarily, or when situated at a distance, is provided by compressing gas at the works to about three atmospheres by means of a pump driven by one bullock. The compressed gas is then delivered in a wrought-iron receiver to the point of consumption, where it is either transferred into fixed receivers and burnt by the aid of suitable regulators, or is delivered into small portable or service gasholders, and burnt in the usual way. A *ghat*, or landing-stage, two miles distant, is thus supplied with 400 cubic feet of gas every day, which is consumed by 30 jets, each burning 1½ cubic feet per hour for nine hours. There have not been any accidents from the distribution of gas in the portable reservoirs, or otherwise. As railway carriages are also supplied with compressed gas, it is evident that the introduction of this branch of service has widely extended the utility of the establishment. Another peculiarity of the Jeypore undertaking is the necessity that exists for the manager to unite the attributes of a farmer to his other acquire- ments, for the purpose of securing a constant and cheap supply of raw material for gas-making. Last year Mr. Tellery personally superintended the sowing of 300 acres with the castor plant (*Ricinus vulgaris*), and the establishment includes a hydraulic oil-pressing appara- tus. The process of extracting the oil for carbonising is as follows:—First, the castor seed is passed through the crusher, when the shells only are broken off. The shells are then picked out by hand, and the seed is again introduced into the crusher, where it is ground to a paste. It is then passed into the heating pan, and, after being well heated it is packed into horsehair bags and filled up hot into the press immediately. After about 20 minutes' pressing, the exuding oil being meanwhile collected, the cake is removed and ground over again. It is subse- quently heated and pressed a second time, until about 33 or 40 per cent. of oil is obtained from the seed. The labour of preparing and pressing the castor seed costs Rs. 1 1a. 8p. (2s.) per maund of oil. The cost of extrac- ting other seed oil is about the same, with the exception of the cost of removing the shells. For generating gas, the oil is used as it comes from the press. Formerly, at other places, when the oil-bearing seeds were car- bonised for gas without previous treatment in this way, the product was overloaded with carbonic acid from the woody part of the seeds, and correspondingly heavy cost for purification was incurred, which by Mr. Tellery's process is entirely avoided. When the estab- lishment was first started, the cost of manufacturing gas was Rs. 23 2a. 5½p. (45s. 10d.) per 1,000 cubic feet; but from the time when the present manager obtained full powers of working independently the cost has been reduced, over an average of six months' working, to Rs. 18 1a. 8p. (35s. 10d.) per 1,000 cubic feet. There will be considerable saving if the manager succeeds in his castor plantation, and he is confident that during the next twelve months the cost will be brought down to Rs. 13 or Rs. 14 (25s. 9d. to 27s. 9d.). The illuminating power of the gas is such, that a burner consuming 1½ cubic feet per hour is equal to 17 or 18 candles, and about 800 cubic feet of purified gas are usually produced from a maund of oil. As a further means of economy, it is proposed to erect an apparatus to burn the tar, which is rather a drug, for the prepara- tion of lamp-black. This is expected to bring in a better profit than the present system of selling the tar at an almost nominal price.

MANILLA HEMP.

The following is a report from Surgeon-General Balfour to the Secretary of State for India, dated October 15, 1880:—

"Mr. Liotard, of the Agricultural Department of the Government of India, has this year (1880) reported on the materials in India, suitable for the manufacture of paper. Several of the fibre-yielding plants are mentioned

by him, and, amongst others, various species of the genus *Musa*, of the plantain or banana tribe, many of which have been grown in the East Indies from the most remote times. At pages 54 to 58, he describes the introduction, in February, 1858, of the Manilla hemp plant, direct from the Philippines, into the Madras districts, by Colonel (now Sir George) Balfour. Nevertheless, the Import Trade Returns of the United Kingdom show a large and continually increasing delivery of hemp from the Philippine Islands, now averaging yearly about 20,000 tons,* valued about half a million sterling. I have ascertained from the London produce brokers, through Dr. Birdwood, of the India Office, that this important article is the true Manilla hemp from the *Musa textilis*, that the bulk of it is delivered in London, where it is made up into cordage and ropes for ships, especially for yachts' running rigging, being very light, strong, and clean, and also for clothes lines. But there is no doubt that the Manilla hemp plant, *Musa textilis*, grows as well in British India as other species of the plantain or banana genus, and that British India could, in a couple of years, supply the London market with all that it could take of Manilla hemp fibre. The prospect of benefiting British India by creating an export trade from it of the extent and value above indicated might well incite to considerable efforts to attain success. In 1861 to 1863 the Madras Revenue Board made continuous efforts† to secure the naturalisation of the plants which Colonel Balfour had introduced, but their efforts seem to have been effectual only in the Wynaad, from which, by 1877, the Conservator of Forests replied that the Philippine variety had been introduced on several of the coffee estates, where it grows remarkably well, and no doubt is felt there as to the value of its fibre. The attention of the Boards and Commissioners of Revenue, and of the Agri-Horticultural Societies might be re-directed to this plant."

STEAM DIGGER.

Where labourers and workmen are continually striking for an increase in their rate of wages—even when, as has occurred recently at Goulburn, N.S.W., they are in receipt of no less than 12s. per day of eight hours—it is not surprising that mechanical inventiveness is stimulated in its efforts to supplant manual labour by machinery. One of the most recent evidences of activity in this direction is the "steam digger," which, first making its appearance at the Carlisle Show of the Royal Agricultural Society last year, has since then been subjected to practical trial. The inventors claim that the steam digger can dig an acre of ground in one hour at a cost of 5s.; in other words, that it can do work equal to the labour of 170 men in a day, or of one man in seven months, which labour would, at ordinary rates represent an expenditure of £21. Compared with the cost of ploughing, the digger gives the following results:—To plough ten acres in one day with the familiar horse-plough would require ten men and ten boys and thirty horses, at a cost of £6, and the estimated cost of similar work with the steam-plough is £4 5s., while the steam digger undertakes to perform the same amount of labour for £2 7s. It is also claimed that the machine produces superior cultivation, and that the "motor," when not employed in digging, may be used for other farm purposes, such as threshi[ng,] grinding. Recent public trials of the steam [digger] show that the machine will dig to any depth [de]foot. In working, a number of sharp-point[ed] are set in motion, digging into the earth and over the soil as cleanly and evenly as the most [skilful] labourer. A space twenty-one feet in breadth [is dug at] a time; but the machine, when travelling [on] roads, can be turned round "end on," and [p]any ordinary thoroughfare. On the vast area[s] in Australia, Canada, Cape Colony, New Zea[land,] other of our colonies where labour is scarc[e] machine would be invaluable. It is equally [useful] on wet, dry, or even frost-bound soil.—*C[...] India.*

	Cwt.	£
*1877	332,304	488,069
1878	421,100	551,856
1879	337,6?7	434,087
1880	407,431	622,776

† 1861—24th April, No. 2,128; 31st May, No. 2,785; 1st June, No. 2,847; 21st June, No. 3,226; 25th June, No. 3,301; 5th August, Nos. 4,212 and 4,219; 1862—13th February, No. 894; 16th February, No. 963; 24th September, No. 6,096.

GENERAL NOTES.

International Medical and Sanitary Ex[hibition].—This Exhibition, organised by the Committee o[f the] Museum of Hygiene, will be opened on Saturd[ay] and continue until August 13. The opening ce[remony will] take place in the Royal Albert Hall, at 4.30 p.m. [and be] presided over by Earl Spencer, Lord President of [the Council].

New Zealand Wool.—The total quantity [of wool ex]ported from New Zealand in 1879, amounted to 62,[...] of the declared value of £3,126,439, against 59,[...] of the declared value of £3,292,807, exported [...] increase of 2,950,554 lbs. in quantity, and a [...] £166,368 in declared value. The exports for th[e] years, ending respectively on the 30th Septem[ber,] follow:—

Year ending 30th September.	Wool c[...] ll[...]
1873	42,23[...]
1874	47,42[...]
1875	49,94[...]
1876	55,97[...]
1877	56,52[...]
1878	62,16[...]
1879	62,64[...]

The wool produce for 1879 only amounted to [...] more in weight than the produce for 1878. Th[...] the wool production has been seriously chec[ked by the] increase of rabbits in some parts of the colony.

Mining Accidents in Victoria.—It appea[rs from the] report of the Chief Inspector of Mines in Vict[oria for the] year 1880 that the total number of accidents dur[ing the year] was 134. The proportionate number of perso[ns ... to] those employed in and about mines has been 1[...] pared with 1·29 per thousand in 1879, and 1·93 [...] in 1874 (the first year in which a "Regulatio[n] Statute" came into operation). The following [...] the number of accidents in the last seven years, [...] with the mining population of the colony duri[ng the] period:—

	Miners Employed.	Accidents.	Killed.	Injure[d]
1874	46,512	296	90	245
1875	42,058	275	88	217
1876	41,581	209	55	170
1877	38,860	213	64	154
1878	37,212	121	40	106
1879	37,195	146	48	112
1880	36,076	134	50	89

Royal Society of Literature.—Mr. T[...] Saunders will read a paper on Wednesday, July [...] p.m., before this society, on "The Recent [...] Palestine."

AL OF THE SOCIETY OF ARTS.

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FRIDAY, JULY 8, 1881.

...ications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

ART FURNITURE EXHIBITION.

...xhibition of Works of Art Applied to ...e, in connection with the Exhibition of ... at the Royal Albert Hall, is now open ... non-transferable season ticket will be ...ny member of the Society on application ...cretary. A ticket, to admit two persons, ...ith the present *Journal.*

...EEDINGS OF THE SOCIETY.

CANTOR LECTURES.

WATCHMAKING,

By Edward Rigg, M.A.

I.—DELIVERED MONDAY, FEB. 7, 1881.

...ion—Units of time—Historical sketch— ...ition of usual forms of watch—Escape- ...-Conditions of accurate timekeeping, and ...ements necessary for their maintenance in ...her class of watch.

I was invited by the Secretary of the ...of Arts to deliver a course of Cantor ... on Watchmaking, it was with much ... but some diffidence, that I undertook ... I felt, as any who thought of the ...must have felt, that some prominent ...of the trade, who had spent a good many ...his life in that industry, and whose views ...erefore be more entitled to the attention ...low workers, could with greater propriety ...upied the position in which I find my- ..., at the same time, I am sanguine enough ...hat, in endeavouring to bring the subject ...non-technical audience, it may be possible ... draw the attention of such watchmakers ... be present, or who may read these ... to certain questions that appear to ...further consideration.

... often seemed to me to be a matter of ...at surprise that the public take so little ... this important mechanical art, an art in ...e are all directly interested, and which, in its highest perfection, has long had a home in this country. The true watchmaker has far more to do than to make a piece of jewellery; and in many ways his work possesses even more interest than that of the engineer; by watchmaker, however, I would not here be understood to mean anyone and every-one who chooses to so designate himself, but one who, besides possessing great manual skill, is able to so combine the several parts of the watch, analysing the subtle phenomena that occur, taking cognisance of the minutest mechanical effect, and calculating its proportions, that he may secure the highest excellence in timekeeping; and, added to all this, he must possess an artistic instinct enabling him to impart a graceful appearance to the mechanism. And yet how many there are whose appreciation of the watchmaker's art is limited to a remark on the delicacy of the parts, and the skill of touch and sight that they indicate. A well-finished machine, or even a piece of high-class cutlery, will not unfrequently be more likely to command attention. It may undoubtedly be said that none but those who make it the business of their life to adjust high-class clocks, watches, and chronometers can appreciate the mental labour that has been expended in bringing these instruments to their present state of perfection; but it is hardly less true that, in the estimation of the public, the science and art involved are ignored, and the watchmaker's shop excites no interest except that occasioned by the purely ornamental nature of the objects exhibited.

Let me give you, at the outset, an illustration of the extraordinary degree of accuracy that is now attained in machines for the measurement of time; and I will select one that can hardly fail to bring this point home to you. The chemical balance is a simple scientific instrument that is specially free from the influence of interfering causes, and yet, in its highest perfection, it cannot be made to indicate less than one-millionth of the load in either pan. Thus, with 1,000 grains in each pan, the balance may indicate $\frac{1}{1000}$th grain. It is no uncommon occurrence to meet with a chronometer that does not vary more than $\frac{2}{10}$ths second per 24 hours, or nearly two-millionths of the time measured out, notwithstanding that it is comparatively a complex mechanism, subject to many sources of irregularity, such as variation of temperature, motive force, consistency of oil, &c.

But, although the construction of timekeepers has been brought to such a degree of perfection, and is a question that concerns us all, it has failed to receive the attention it deserves. Its literature in this country is, with one or two notable exceptions, valueless, or nearly so, as a means of interesting non-technical readers. The art has thus been neglected by amateurs, while the trade has for many years been in a somewhat desponding state. But this has not been the case in other countries. France is remarkably rich in horological literature; and the Swiss, regarding watchmaking as a staple industry of their country, have never failed to do all in their power to promote its interests.

We cannot but feel, therefore, that a special consideration of the subject of watchmaking would at this time be particularly opportune in England, and if these three lectures are instrumental in leading to any discussion of the present

condition and future prospects of this most interesting art among us, I shall feel that my labours have been well repaid. While endeavouring to do justice to the exceptional interest which my subject possesses for amateurs and those who are not concerned with it as a commercial pursuit, I shall endeavour, by a comparison of the methods adopted at the several centres of this industry, to ascertain whether changes could, with advantage, be introduced into our system of manufacture, in order to enable England not only to render more secure the position she has so long held, of producing timekeepers unsurpassed by those of any other country, but also to do more than she at present does in the cheaper markets. For it appears that, while the annual total productions of all the other centres of the watch manufacture, in France, Switzerland, Germany, and America, have shown a marked advance, that of England has at best remained stationary—a fact which the statistics of the English watch and clock trades, given in the next lecture, will bring into prominence.

With the exception of turret, regulator, and chime clocks, England has already quite lost the trade in this branch of horology; it retains, however, the first place in the production of high-class watches, and, as regards chronometers, we may still claim to be the foremost producers, for not only are our own naval and mercantile marine supplied, but also to a very great extent those of most other countries.

From the following table, which has been compiled by M. Saunier, it will be seen that in money value England contributes about one-fifteenth of the total production of the world, including all branches of horology, while nine-fifteenths of this total amount is manufactured in France and Switzerland.

Annual Production of Horological Instruments in the World.

France.—Turret clocks, timepieces, watches, and chronometers..	£2,620,000
Switzerland.—Watches	2,400,000
America.—Watches and clocks	1,280,000
Germany.—Clocks	1,000,000
England.—Chronometers, watches	640,000
Austria.—Clocks	400,000

Such a table cannot be more than the very roughest approximation, on account of the difficulty there is in getting reliable statistics, but, if we accept its conclusions, showing as they do that the value of our produce is small in comparison with that of other countries, we must remember that much of the English work bears a very high stamp, and, even if the fabrication of ordinary watches and timepieces is at the present day in great part appropriated by other countries, we yet have a branch of the trade peculiarly our own which well deserves encouragement; and, at the same time, let us not despair of recovering some of the lost ground in cheaper markets. A capacity for seeing the good as well as the bad points in the productions of our neighbours, and a greater willingness to modify our established practice as experience dictates, would greatly help to redeem the character of the cheaper class of English watch.

It may be said that such questions are too technical to interest a general audience, and that they should be discussed and settled by those
commercially interested in the art. But
altogether the case, and for several reas
watchmaker's art has too long been l
care of itself, the public regarding it as
into which they could not enter, and wl
possess little or no interest for them i
And yet they often take care to dictate
more or less unreasonable, because they
dicial to the advance of the art; and the
wearing very thin and very small watche
for long periods without the slightest re
fact that such conditions are fatal to
keeping. The absence of literature is,
to some extent, responsible for thi
things, but, neglected though it h
hope to be able to show, in the cou
lectures, that our English watch tr
well worthy of attention on accou
has been done in the past, also urgen
it with a view to improving its p
the future. And in order that I mig
the subject to some extent from actual
I have visited several centres of the
this country, Coventry, Prescot, and B
being acquainted already with the work
well; and I would take this early op
thanking very sincerely all those mem
trade who have enabled me, often at
convenience to themselves, to see m
numerous operations that are involved
duction of a watch. I shall more
specify those to whom I am thus inde
second lecture, when explaining the
manufacture.

Before proceeding to consider briefl
stages through which timekeepers ha
arriving at their present state of p
may be well to ask, What is time? T
is more easily asked than answere
cannot picture to ourselves what ti
We can only appreciate an interval of
period between two events, and i
sufficient evidence to show that
between two events, A and B, is n
nor less than the period between
events, C and D, we say that the inter
are equal. But such a statement
supposition that the evidence is suffici
division of time must ultimately res
position, doubtless highly probable,
certain, since we are not so organis
able to test it, that the period of rec
definite phenomenon is invariable.

It is, then, well to remember that
our arrangements for the measurem
can be justified, they do rest on a
which is entirely beyond our powe
prove or disprove. If the above assum
ever, be granted, we at once have
testing the time-keeping properties o
and watches, and no further supposit
made.

From this point of view, a watch
not an instrument for causing an ind
at a uniform rate, but rather an arra
conveniently counting up equal short
time, *i.e.*, the periods represented by os
the balance or pendulum.

It should be observed that the
the period of time that is taken

nt varies according to circumstances, unit of weight is a grain, ounce, pound, cording to the value or bulk of the whose weight an expression is required. take thousands of years as a unit, s comparable with the periods assumed lapsed between successive important the formation of the earth's crust. on the other hand, often deal with e fractions of a second. Thus, light is ravel at a rate of about 196,000 miles , and yet it was found possible to his velocity from so short a period as onths of a second, the time required to a distance of not more than six miles. nary transactions of life, a minute, hour, n week, may be considered as a unit, to circumstances; and it is a marked ic of modern life that the tendency is e adoption of the shorter intervals as

knows that a day is the interval that ween two successive risings or settings and an hour is understood to be 1-24th rval, while the minute and second are $\frac{1}{60}$th and $\frac{1}{3600}$th of an hour. But it is pointing out that the measurement of so simple as would appear from such a Let it be granted that each revolution is performed in the same interval of ay is defined as the period that elapses e departure of any meridian from a ody and its succeeding return to it, as the aid of a transit instrument; and, n were the sole moving body in the ransit observations made on all the odies would prove these intervals to be the same. The stars may, for all rposes, be regarded as stationary; and earth's revolutions be determined by s made on any given star, all days will length; the sun, moon, and planets er, also in continual motion, with ot only different from each other, but each particular body. The length of a s determined by any of these bodies, ssarily be a variable quantity. To case of a solar day. Our earth m west to east, performing each in a constant period; but its nd the sun, that is, in the ecliptic, at the sun appears to be revolv- t, also from west to east, but with a elocity; any given point on the earth's to perform more than a complete before its meridian can, so to speak, e sun, and the solar day will be longer eriod occupied by a revolution of the corresponding amount. The case is, aking, analogous to that of two suc- cidences of the hour and minute hands Assume that the hour hand indicates l the minute hand a point on the earth's l that they are together at noon. The d at once advances on the hour hand, remained stationary, would again coin- in 60 minutes; but, in the meanwhile, and has advanced through a space of , and thus, to an observer supposed to extremity of the minute hand, the "solar day" would be rather more than 65 minutes, although a complete revolution was performed in 60 minutes. Owing to various causes, however, into which we cannot now enter, the difference in the case of the sun is a variable quantity; it can be determined by the aid of tables of the equation of time.

The day of 24 hours is the mean or average of all the apparent solar days in a year. It does not represent the time occupied by the earth in performing a revolution on its axis, a period which, observed from a distant fixed star, would be found to be 23 h. 56 min. 4·09 sec. of mean solar time; and, although an arbitrary division of time, it has important advantages, because clocks cannot be made conveniently to go with the sun, but can be arranged to go uniformly. It is thus seen that we have three kinds of day to measure. A true or apparent solar day is the period between two successive coincidences of the sun with the meridian of any given place. It is the interval between two successive noons on a sundial, but cannot be recorded by an ordinary clock since the days are unequal. A mean solar or civil day is the average of all the true solar days in a year, and corresponds to Greenwich mean time, or what is often termed "railway" time. Lastly, a sidereal day is the period occupied by each revolution of the earth, or, as already explained, 23 h. 56 min. 4·09 sec. of mean solar time. All sidereal days are of equal length, and thus, if a watch or clock be set to gain 3 min. 55·91 sec. per day on Greenwich mean time, it will indicate sidereal time, assuming, of course, that it be in the first instance set with a standard sidereal clock.

Although my principal object is to consider the systems of manufacture of watches, there are other points of view from which the measurement of time possesses much interest, not the least important of these being the historical. I propose, therefore, at the outset, to briefly enumerate the several stages time measurers have passed through, especially referring to those of a portable character. The natural divisions of time, which cannot have escaped observation in the remotest antiquity, are such as the rising and setting of the sun, and the phases of the moon. But there is very great uncertainty as to the earliest means in use for the measurement of time. Certain French writers assert that the obelisks were originally set up as a means of indicating the time by the sun's shadow, a view which seems to derive some support from the term "finger of the sun," applied to them by the Egyptian priests. On the other hand, their position at the entrances to temples, &c., seem to render this view doubtful. The first obelisk is said to have been set up B.C. 1485.

The sundial may have been the result of a gradual improvement in some such form of time indicator, but the evidence as to the precise date of its invention is far from definite. The text in the Book of Kings, referring to the "dial of Ahaz," who reigned about 730 B.C., cannot be accepted as conclusive evidence of their use at that period, as the word translated "dial," is the same as is rendered "degrees," in the same verse. Some authorities assign the discovery to Anaximander (B.C. 610—547), the reputed inventor of maps; but, after all, the question turns on the definition of a sundial, for the Egyptian obelisks would

suffice to determine mid-day and, in a sense, to subdivide the day. The essential feature of a sundial is a style fixed parallel to the axis of the earth; its inclination will, therefore, gradually increase as we move from the equator, where it lies horizontal, to the poles, where it is vertical. The shadow of this style is cast on to a graduated circle.

The first time-measurer, whose action did not depend on astronomical phenomena, was the clepsydra or water-clock, an instrument which, probably existing in a simple form much earlier, was brought to a high state of development by Ctesibius, about B.C. 250. In its primary form it doubtless consisted of two vessels, one of which, containing water, was fixed above the other, and into this latter the liquid gradually escaped, indicating the time by the rise of its level. It is curious to note that the Brahmins of the present day are stated to employ a similar system for the measurement of periods of time. A copper vessel perforated with a small hole is floated on water, and immediately on its becoming full the attendant empties it, and strikes the hour of the day or night. But the problem of adapting the clepsydra to indicate the time was one of considerable complexity. For it must be remembered that the day and night were each divided into twelve hours, these hours therefore differed between themselves, and varied from day to day. The ingenuity displayed in the construction of these machines is truly wonderful; some of them automatically adjusted for this variation in the day's length, while in others the adjustment required to be made by hand. Anyone interested in their construction will find several forms illustrated and described in Rees's "Cyclopædia," article "Clepsydra."

If we may credit the accounts that have been handed down to us, some remarkably complicated mechanisms, based on the water-clock, and giving all the movements of the heavenly bodies, signs of the zodiac, &c., as well as indicating the time, were invented before the next great advance in horology, the introduction of a weight motor ten or twelve centuries later. I will only add that the principle of the clepsydra is still of very great value to the physical experimentalist where brief and irregular intervals of time require to be measured with accuracy. With a properly arranged apparatus, it is only necessary for him, by depressing a handle, to start the flow of water, and to release the handle immediately on the completion of the observation. The weight of water thus allowed to escape affords a means of measuring the time elapsed.

The sand-glass, or clepsammium, was probably discovered subsequently to the water-clock, and authorities differ very much as to the date of its first introduction. It is, perhaps, safe to assume that this was at some period during the first three centuries of the Christian era.

Water appears to have afforded the sole motive power for clocks till towards the close of the tenth century, when the celebrated Pope Sylvester II. is generally credited with having constructed a clock for Magdeburg, which was driven by a weight. Professor Hamberger, however, in a paper read in the year 1758, and published by Beckmann,* doubts his title to the discovery, pointing out that no mention is made in the original by Dithmar, of either wheels or weigh considers the invention to have more consisted of a sundial, and substitutes Abbot of Hirschau, in the eleventh ce having introduced a timekeeper which w events, neither a sundial nor a water-clock; subsequent part of his paper he suggests Saracens, "to whom we are indebted for the mathematical sciences," were in all pr inventors of clocks moved by wheels and

But the references to horology in the of this early period are exceedingly mea we have no precise evidence of the use of controlled by what is now termed an esc until the 14th century, when the verge, or escapement, one form of which is shown

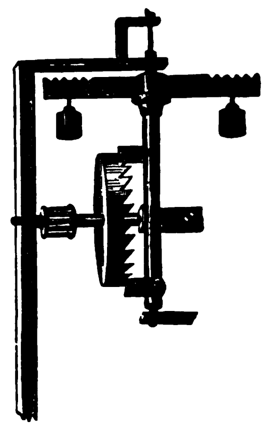

Fig. 1.

came into use. The mode of action of t explained when we come to consider es generally.

It is impossible to believe that no pr made during these four hundred years, single inventor is entitled to the entir the discovery of the new clocks. N definitely say who it was that first i them; for about the same time, early in teenth century, there lived, in England, Wallingford, Abbot of St. Albans (which curious coincidence, is now being restor at the expense of Sir E. Beckett, one of prominent living horologists); in Italy, J Dodis, doctor and astronomer of Padua Germany, Henry de Vic, all of whom famous as clockmakers.

The next important horological adva to have been made by Peter Hele, a clock Nuremberg, who, in the early part of the century, succeeded in overcoming the difficulty in the way of a portable timek fact that the motive power was obtain descending weight; this he replaced by steel spring. In the early watches, w tained the name of "Nuremberg eggs," escapement, similar to that already in clocks, was employed. The balance, in so only a straight bar with weights at ei represented in Fig. 2, was not provided balance-spring, for the verge escapement

* "History of Inventions," vol. i., p. 340. 4th Edition. 1846.

t others in being capable of performing ons as a controller of the mechanism, ry imperfectly, without this addition.

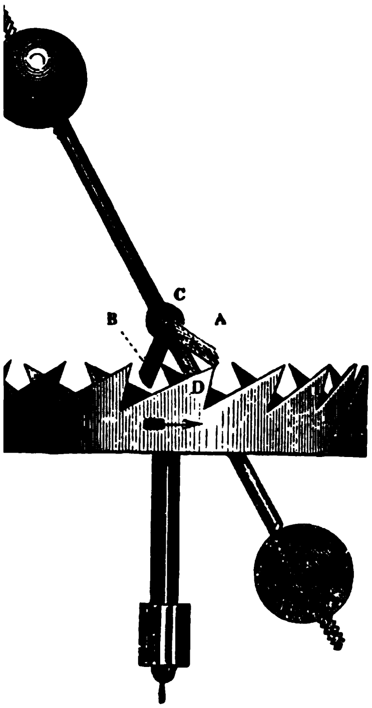

FIG. 2.

early watches, a peculiar device, known kfreed, seems to have been first used for a greater degree of uniformity in the rce. No description of this arrangement handed down to us, but I have made this Fig. 3), based on a brief account given by Morgan, Esq.* It will at least afford a n as to the manner in which the stack- have worked. As a spring is gradually in a barrel, the force tending to cause ncreases, and the watch will gain. The of the mainspring being fixed, the inner d to an arbor that carries the wheel A, , which engages with the wheel B, of 24 space (D) of this wheel being left uncut a stop. As the arbor of A makes three rotations in a day, B will turn once in period. On its axis is fixed a cam of n form as C, against which a powerful esses. Assume that, in unwinding, A the direction of the hands of a watch. opposed by the spring pressing on C to n of B will gradually diminish as it rotates. spring is about half down, a period is uring which the opposing force remains and afterwards, while pressing against ve face of the cam, it supplements the he mainspring to a gradually increasing hus the tendency is to secure an approxi- ormity in the motive force.

entor of the fusee, and the date of its first use in a watch in place of the stackfreed, are alike unknown; but a very remarkable clock in the possession of the Society of Antiquaries,*

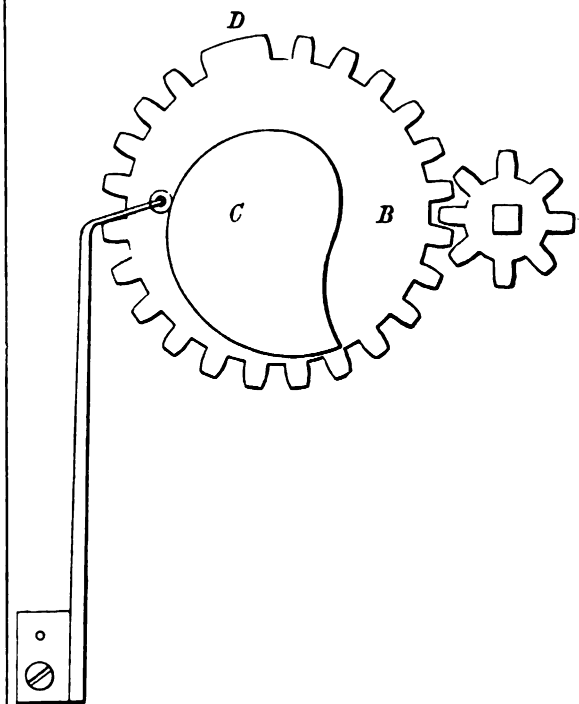

FIG. 3.

seems to afford authentic evidence of its having been employed for clocks as early as 1525. The timepiece in question, bears the name of Jacob Zech, of Prague.

It is worthy of note that, up to this period, timekeepers appear to have been employed for civil purposes and in monasteries, not as astronomical instruments; but it now began to be felt that they could render important aid in that branch of science. The credit of having first used a clock in the observatory, is claimed for Walther, of Nuremberg, towards the end of the fifteenth century; and in 1530, very shortly before the announcement of Hele's discovery, G. Frisius, a Dutch astronomer, suggested, that longitude might be determined at sea by the aid of portable clocks, thus opening up a question which, more than any other, has stimulated the progress of horology.

Galileo, about 1639, made the next great advance when he published his treatise on the properties of the pendulum, discovered, probably, towards the close of the previous century. But he did not actually apply it to a clock, although he is asserted to have dictated to his son Vincent, after being struck with blindness, the description of a pendulum clock; the honour of this applica- tion is claimed by Huyghens, V. Galileo, and Hooke.

I cannot pretend to discuss their respective claims; suffice it to say that to Huyghens, whose

* "Archæologia" (1849), vol. xxxiii., p. 296.

* "Archæologia" (1849), vol. xxxiii., p. 8.

profound knowledge and ingenuity raised horology from being a purely empirical art into the position of a science, is almost universally awarded the credit of this invention. Although the substitution of the pendulum for the old form of balance, had immeasurably improved the timekeeping properties of the clock, Huyghens, finding that the vibrations of a pendulum are not rigorously isochronal, or performed in equal times when of varying extent, endeavoured by the aid of geometry to further increase its accuracy, and was thus led to the discovery that if a pendulum be caused to perform a cycloidal instead of a circular path the vibrations will always occupy equal intervals of time. This profound research into the properties of the pendulum was mainly prompted by an ambition to employ the clock for determining longitudes at sea, in accordance with the suggestion of Frisius, nearly a century and a half previously; and Fig. 4

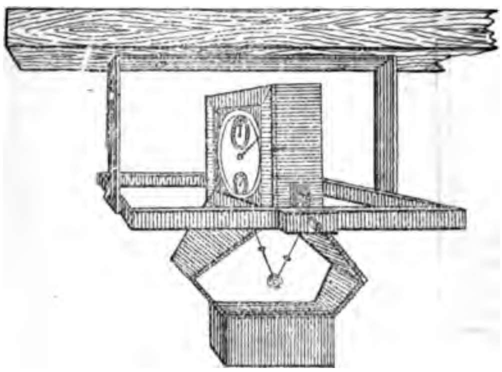

FIG. 4.

is very interesting as representing a form of clock, supported in gimbals, and maintained steady by a heavy weight below, which Huyghens proposed for that purpose. Robert Hooke, however, assures us that Lord Kincardine had, a few years previously, experimented on a similar form of clock; and the very first number of the "Philosophical Transactions" of the Royal Society, published in March, 1665, contains a note, describing the successful employment of these "pendulum watches" by Major Holmes, on a voyage from Guinea to the "Isle of Fuego."

Huyghens was led, by his investigations, to the discovery of a fact of infinite importance in the exact measurement of time, the fact that when a pendulum oscillates through very short arcs, their periods are isochronal within the limits of observation. The verge escapement, however, the only one in use at the time, required a vibration of considerable extent, so that the great geometer was precluded from taking advantage of his discovery, which follows directly from his law of the cycloidal path, since, for short arcs, the circular and cycloidal paths are practically coincident.

It was about this time (1660) that the discovery of the balance-spring, by which portable timekeepers indicating the time with any degree of accuracy were, for the first time, rendered possible, was announced by Dr. Robert Hooke; and his invention was very soon claimed by Huyghens and *Hautefeuille*. Although authorities generally concur in admitting the Englishman's title to ha
first applied a spring to the balance, Huyg
seems to have first employed, in 1674, a spiral
spring, such as is in universal use at the pre
day. This well-known arrangement is shown
Fig. 5, from which it will be seen that the i

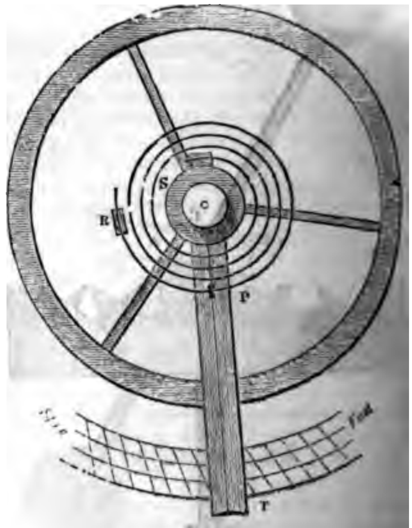

FIG. 5.

end of the spring is attached to the balance
R is a stud fixed in the balance-cock, in whi
outer end is fastened; and, at P, the outer
passes between two pins in the index, or r
lator, T.

The adaptation of the pendulum to cl
and the application of a steel spring to the bal
gave a stimulus towards some improvement o
folliot or verge escapement, the only one in us
either clocks or watches. So long as it conti
in use, Huyghens was compelled to secure cycl
vibrations in clocks, since relatively long ar
vibration were essential. This he did by app
the cycloidal cheeks to the upper end of the
dulum rod, in the manner shown in Fig. 6. 1

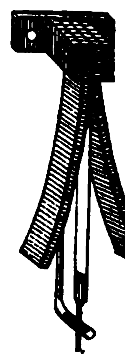

FIG. 6.

two shaded pieces are in the form of a cycloid,
the pendulum is suspended by two parallel
threads, which alternately wrap over these ch

oved that the path of the bob will also . In 1680, Clement, a London clock-e a great step in advance by intro-recoil) anchor escapement, with which l therefore more nearly isochronal .tion, were possible. The form of the changed to that shown in Fig. 7, so as

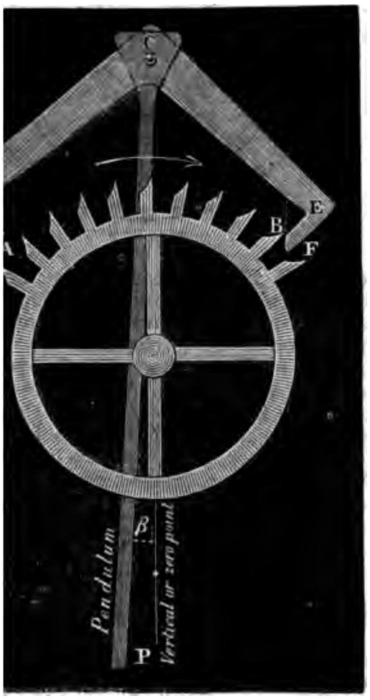

FIG. 7.

ıd-beat instead of a recoil escapement, r years later, by G. Graham, a man ne more than any other Englishman the art of horology. His more im-entions, the cylinder and dead-beat pements, and the mercurial pendulum, steemed at the present day; the well-liron pendulum was also first sug-im, although carried out by Harrison. is reasonable to assume that his im- in the anchor escapement led to the ventions, since the rates of clocks had ısly been sufficiently good to render sused by changes of temperature of any)ther escapements and other methods sation have of course been invented ım's day, and the details of workman- improved, but he is unquestion-d to the credit of having first made mical regulator possible, and the unimportance of the few changes during the 160 years that have rs indisputable testimony to this fact. provements in stationary clocks were followed by important advances timekeepers, with a view to the on of longitude at sea; an operation atially depends on the exact coinci-dence of two timekeepers that are separated from one another. This is obviously a problem possessing the highest commercial importance, and the labours devoted to the perfection of marine chronometers have, at the same time, given us all the greatest improvements in pocket watches. The interest excited by the question can hardly be appreciated at the present day, when every ship carries one or more chronometers as a matter of course; all the maritime Governments offered rewards for its solution, and our own Parliament, on the recommendation of a committee of which the immortal Newton was a member, voted in 1714 a sum of £20,000 to the inventor of a marine timepiece that should not vary more than two minutes in 42 days, thus giving the longitude to within half a degree at the end of that period.

Henry Sully, an Englishman living in France, was one of the first to take the problem seriously in hand, and in 1723 he completed a clock for use at sea. It can hardly be taken as a proof of any radical advance in the art, and, considering how highly esteemed its inventor was as a horologist, we may be surprised that he should have designed such an instrument. Moinet assigns as a reason for giving a somewhat detailed description, that it will "serve as an illustration of the errors into which a man of ability and some experience may fall." A heavy circular balance is supported by a horizontal axis on anti-friction bearings. This axis also carries a radial pair of curved cheeks, and an index, the whole being in equipoise. The escapement by which the impulse is communicated partakes of both the verge and lever forms. A cord attached to the balance-staff, and passing alternately over the two cheeks, is connected with a circular arc forming part of a horizontal lever, also on anti-friction bearings, with which this arc is concentric. While the lever is raised by the action of the escapement, its descent gives an impulse to the balance; the action of the weighted lever, then, corresponds to that of a balance-spring. It is useless to point out the objections to such an arrangement, which, after all, only involves the use of a pendulum in disguise; the friction throughout the escapement was excessive, and the instrument was not independent of position or latitude. He seems to have gone out of his way to avoid using the balance-spring, then well known, and failed to see how essential it was to entirely change the escapement itself. This most important investigation was taken in hand by his immediate successors, Harrison and P. Le Roy, the inventors of a special remontoire and of detached escapements respectively, and the former secured the award of the English Government in 1767. In a remontoire escapement the motive force, instead of acting directly on the balance, is employed to raise a weight or spring which, in turn, impels the balance, the object in view being to secure a strictly uniform motive force. But horologists now generally admit that in a watch or chronometer such a precaution is entirely unnecessary, and it was Le Roy's great discovery, first announced in 1748, that led the way to the final solution of the problem, the chronometer escapement of the present day. I shall presently have occasion to refer to the principle of detachment which he introduced, and would here only explain that it consists in releas-

ing the balance from its connection with the other parts of the escapement during the greater part of its motion.

Portable timekeepers had now reached such a degree of perfection that their rates were appreciably affected not only by variations of temperature, but also by the want of isochronism when the arcs of vibration were of varying extent. Harrison's elegant mode of counteracting the first of these interfering causes by a bimetallic strip applied in various ways was only equalled by that most beautiful discovery of Le Roy's—the isochronal balance-spring; they were both essential to the perfecting of the marine chronometer, and it appears we can no more dispense with the practical suggestions of the one inventor, than with the more theoretical discovery of the other.

Many great horologists have lived since the days of these men, but they have worked mainly on the lines indicated by them. It would be travelling beyond the limits of a general historical sketch to refer to the special work of Arnold, Earnshaw, Berthoud, Breguet, and others, in the endeavour to improve the marine chronometer. We are mainly concerned with the pocket watch, and it is noticeable that, prior to 1760, attention seems to have been directed towards increasing the complexity rather than the timekeeping properties of the instrument. Thus the invention of repeaters took place immediately after that of the balance-spring, namely in 1676 and Johannes Cocclæus states that Hele even made a "striking watch" early in the sixteenth century; indeed, throughout that century, striking, alarum, and calendar watches seem to have been not uncommon.

The verge or "pallet" escapement was the only one in use for watches until 1700, when Graham perfected his cylinder escapement, based on a suggestion of his master, Tompion. This form, though unsuited to the chronometer, has been used more than any other in watches, for reasons that will be evident when we consider it more in detail. It cannot be doubted, that many efforts were made to adapt to watches the dead-beat escapement, which had proved to be of so much value in clocks, but an important difficulty lay in the fact, that, while this form of escapement requires only a short arc of oscillation of the pallets, the regularity in the rate of a balance is materially impaired if the extent of its arc of vibration is reduced. It was essential then to so co-ordinate the balance and pallets, that these two conditions were satisfied. The Abbé Hautefeuille invented an escapement as early as 1722, which satisfied them, but fresh sources of error were introduced. It is known as the rack lever, and shown in Fig. 8. The balance, C D, and escape-wheel, A, are concentric, but on inde-pendent axes. On the balance-staff is a pinion, F, which engages with the segmental rack, E, at one end of a poised lever, E G; to this are fixed the pallets, B, as in the modern lever watch. Indeed, this is the forerunner of our modern escapement, from which, however, it differs in one essential particular. The balance is never liberated from the lever. This very important modification was introduced about 50 years subsequently by Thomas Mudge, a well-known English maker, in a watch he made for Queen Charlotte. His own account of the invention shows that his escapement closely resembled the "right-line lever" very fı met with in Geneva watches; the valu

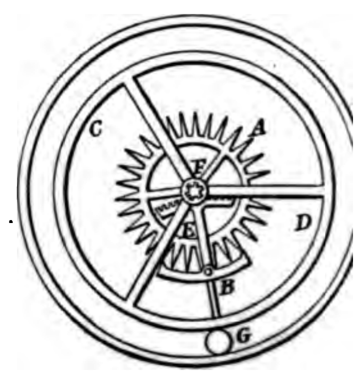

Fig. 8.*

discovery of Mudge's consists in the f during the greater part of its vibration th is detached or free to move out of contact other portion of the mechanism.

One other radical change in the pock remains to be mentioned. A few years afte effected this improvement (1766), the c Lépine, associated with Voltaire in th factory at Ferney, introduced his importa fications in the arrangement of a watch- which have been maintained until the pre on the Continent, in all but the cheapes factures. He suppressed the fusee and c pillar-plate, and one pivot-hole of the bar one plate only being used, and the top piv by separate cocks. The fusee was thus re the barrel, which, being provided with te municated its motion direct to the min axis, and became known as the "going [These changes were made clear by the large diagram and a model, showing all of a watch, kindly lent by Sir John Benn

We have now very briefly traced the l horology from the earliest times to the i originators of the clocks, chronomet watches in use at the present day. W while the escapement used for most of clocks, Graham's dead-beat, was invente as 1700, the commencement of the preser found the modern lever and chronomete ments already the subject of investigatio patient experimental determination of suitable proportions, and of various detai struction, of these as well as of the l escapement, has mainly occupied horolog that period. The principal errors to whi is subject had been overcome by Graham Harrison and many who succeeded him end to avoid irregularities in the rate, owin of isochronism, by a constant force or re escapement, relying on this absolute u in the motive power giving an arc tion of invariable extent; Le Roy's investigation into the action of the balan proved, however. that the true solutio problem lay in the fact that there is a l

* This block, taken from Nelthropp's "Treatise work," is kindly lent by Messrs. Spon. Figs. 2, 5, and Sir E. Beckett's "Clocks, Watches, and Bells," Lockwood and Co.).

;iven spring, providing it is well made, which s vibrations of varying extent to be per- ›d in equal times, just as, with the pendulum, is a path, the cycloid, that alone secures ;t isochronism. That other principal source ›gularity in clocks—variation of temperature ›cts portable timekeepers to a still greater ›e, and although more inventive power has expended on the question of compensation on any other, it is still but partially solved; d, it is well worthy of note, as illustrating at the remarkable progress made by the earlier ogists and the very slight advance made their day, that the compensation balance, n in Fig. 9, which is now often used in

FIG. 9.

ıometers and always used in the best hes, differs in no respect from those em- ›d by Arnold and Earnshaw at the latter ›f the eighteenth and beginning of the present ıries. Arnold, as early as 1775, took out a ıt for the cylindrical or helical balance-spring used in chronometers, and, nine years after, ıet invented his flat balance-spring with over- which is now esteemed the best for watches.

(*To be Continued.*)

DOMESTIC ECONOMY CONGRESS.

(*Report continued from p. 641.*)

e meeting of Thursday, 23rd June, was held e Royal Albert Hall, at 11 a.m.; Mrs. DACRE ›EN in the chair, and Dr. MANN, F.R.C.S., ›sor.

ON C.—THE DWELLING: WARMING, CLEANING, AND VENTILATION.

. **Mann** called attention to the fact that the meeting ›resided over by a lady, the Assessor simply acting r assistant, and desired that all remarks, therefore, d be addressed to her.

s. Dacre Craven read a paper on "Warming, ıing, and Ventilation of Schools and Dwellings in ›on and large Towns, from a Nurse's Point of ."

s. Dacre Craven, in answer to the question how › could best acquire the practical knowledge ›sted, said that nurses for the sick poor were ›d at Bloomsbury-square, and they might teach in ›s parishes.

Lady suggested that the St. John's Ambulance nisation might be made useful for this purpose.

Henry Cole *asked what age Mrs. Dacre Craven* would recommend should be fixed as the earliest for the teaching she recommended? He desired to emphasise the point that a commencement could not be made too early, and should certainly be made in the infant school. With respect to the defects in good houses as well as bad, both in London and the country, even in Birmingham, where the people lived under an efficient and watchful municipal despotism, he found in a house he was going to occupy there a stream of sewer gas flowing into the cellar, and that the water was not potable. He found all the defects that could well exist in a house, and had saved his health by taking care to get them remedied at once by making complaint in the proper quarters.

Rev. Dacre Craven said that in old-fashioned houses windows were not constructed to open at the top. In his own house in London, built a hundred years ago, not one of the windows had been so made, and he had had to remedy that defect. Many people really did not seem to understand that opening windows in that way was a necessity for letting out foul air, and often their only chance of getting proper ventilation was when a window happened to be broken. Most simple means could be used for the purpose if people would only adopt them, as it was an easy thing to leave a window open for a small space at the top and to hold it up at the bottom, even in the absence of proper sashes, by the insertion of a piece of stick.

Mrs. Talbot said she had found the advantage of recommending, in latticed windows of small houses, the knocking out one or two of the small lattice panes.

Sir Henry Cole said there was a general and profound ignorance on the subject of ventilation, and even where in schools the necessary arrangements were made for obtaining it, the students would manage to get rid of them if they possibly could. Women, he thought, would be much better advocates and inspectors in these matters among poor people than men.

Miss Kenrick said there was no difficulty at all in making children, in the 4th, 5th, and 6th standards, thoroughly understand what was best to be done, in cases of sickness, scarlet fever, changing linen, and so on. They gave their mothers the benefit of the instruction they had received, and by following what their children were able to tell them the parents were often successful in preventing the spread of disease.

Frau Morgenstein offered a few remarks in German, giving her experience of her schools of cookery in Berlin, where 10,000 workpeople were daily fed. She had also interested herself in taking females direct from prison, and by educating them in these matters, enabling them to become respectable members of society.

Mrs. Dacre Craven said Frau Morgenstein's remarks would have more application in the cookery section.

Dr. Mann said that the great objection to open windows on the score of draught, might be obviated by the use of copper wire gauze, hooks, and a few simple appliances.

Mrs. Dacre Craven suggested that the foul air from sinks and dust-bins might still enter, and that care must be taken to prevent any danger from that source.

Lady Stuart Hogg thought poor people might find difficulty in providing themselves with the copper gauze and other things recommended.

Dr. Mann said difficulties would soon disappear when people were once made to understand what was required to be done.

Paper by Miss Pilkington, on "The Walton School Laundry," was read by **Miss Webb**.

Miss Guthrie Wright recapitulated from a small hand-book she had written, directions for washing as given at the Edinburgh School of Domestic Economy.

Sir Henry Cole referred to an order promulgated as long ago as 1857 by Mr. (now Sir R. R. W.) Lingen, Secretary of the Treasury, with regard to the establishment of laundries, and remarked that a miserable decadence had taken place since that time. He was unable to say whether laundries did exist in all the female training colleges, but from some cause or other it was found that where established it was cheaper to give out the washing than that it should be done by the students themselves.

Miss Harriett Martin's paper, "Washing-day in Cottages and Small Dwellings; Some Hints upon the Method of Teaching Washing," was read by **Dr. Mann.**

Rev. Dacre Craven said few houses in London possessed means of obtaining soft water. Teachers would be very willing to instruct girls how to wash by practical demonstration, but proper washhouses should be provided for the purpose, for it would be impossible for much good to be done with a board and a piece of calico; and the schoolmistress of the present day might not care to give practical instruction at the washing-tub. Still, that was the only way in which it could be done properly.

Sir Henry Cole thought the practical teaching might be given in public laundries if established. Such laundries might be organised in connection with the Board schools, and thus utilised for teaching purposes.

Mrs. Talbot considered that any School Board which proposed to take the ratepayers' money for building a laundry would raise a storm of opposition.

Sir Henry Cole was not proposing that that should be done, but that the parochial powers should establish baths and washhouses, and co-operate with the School Board for their use for teaching purposes. He was glad to find that in Bermondsey and some other parishes in London buildings of that description had been erected, and the matter was one which merely required a little organisation.

Miss Guthrie Wright thought that poor children in schools were already over-burdened by teaching, and she thought laundry work should not be added. The difficulty might be solved by the adoption of the continental plan of establishing technical schools, to which girls might go after leaving the elementary schools. Such establishments might work either under the Board or in connection with our public schools, such as that for domestic economy, and there the girls might go through a three or six months' course of teaching in laundry work, dressmaking, or other subjects, which would enable them to find better occupation in after-life. By such a plan as that, the difficulty of teaching children domestic economy in schools would be avoided.

Sir Henry Cole urged that in some respects the Education Code was too exacting upon young children, in subjects which could be of no great use to them in comparison with the teaching of domestic economy subjects. Poetry, algebra, Euclid, French, and German, were some of the matters he alluded to.

Mrs. Talbot said that part of the Code applied to boys, and they could not be taught more than two of those subjects.

Sir Henry Cole said that was two too many. Teaching the children such knowledge was really time and labour thrown away.

Mrs. Talbot added that extra subjects could not be imposed upon the girls until they had been taught domestic economy. It was an advantage to girls and boys alike to learn to understand good cooking.

Sir Henry Cole's argument was, that children were pressed too heavily by the Code, which demanded reading, writing, arithmetic, and grammar from the infants in Standard I. Standard II. required from children of eight, among other matters, notation and numeration up to 100,000, and they had much better learn something about washing. A chil[illegible] too young to be taught the simple principle[illegible] economy.

Mrs. Dacre Craven said it was a fair que[illegible] some of the subjects imposed by the Code [illegible] left out in favour of others which woul[illegible] useful.

Mrs. Talbot objected that teachers had [illegible] enough to do; and said they would neve[illegible] teach washing in addition. Public wash[illegible] not so eagerly sought after by poor peopl[illegible] to be considered; and in her own town, [illegible] ment of the kind had been shut up, becaus[illegible] would not go out in public and expose [illegible] their clothing to their neighbours. In L[illegible] ever, they might accept the alternative to[illegible] the one room occupied by the family.

Mrs. Dacre Craven hoped that in anothe[illegible] the poor would have better houses to live i[illegible] accommodation.

Mrs. Tulloch believed it would be a mist[illegible] duce washing as part of the school educatio[illegible] child should be put to stand over a wash-tu[illegible] clothing to manipulate, as the age of 1[illegible] early enough for that. It was really not [illegible] school education at all.

Mrs. Dacre Craven remarked that, un[illegible] poor children were taken away from school [illegible] were 13, as they were too useful at home t[illegible] to stay. She had herself learned to wash a[illegible] in Germany, and could testify to the gre[illegible] involved.

Dr. Mann pointed out that to some extent [illegible] wandering from the question before them, v[illegible] some easy and simple means might not [illegible] teaching children the methods or first princi[illegible] ing by, if necessary, a little alleviation of ot[illegible] of instruction.

A Lady offered, on behalf of Frau Mo[illegible] paper on the subject of teaching washing.

Mrs. Dacre Craven said it would be glad [illegible] She had understood that lady's previous r[illegible] rather outside the subject, referring as th[illegible] manner in which poor people were fed in [illegible] not to washing, cleaning, and ventilation.

Mr. E. A. Hadley's paper, on "Pure Ai[illegible] liness, the True Basis of Health and Comfo[illegible] Reach of All," was read by **Rev. Dacre Cr[illegible]**

Capt. Douglas Galton, C.B., F.R.S., read "The Maintenance of Pure Air in Dwellin[illegible]

Dr. Mann expressed the indebtedness of t[illegible] to Captain Galton for his valuable paper, fo[illegible] ought to be doubly grateful, as he had pr[illegible] special request.

Mrs. Dacre Craven asked whether Cap[illegible] would recommend the placing of dust and r[illegible] houses for daily removal.

Capt. Galton was in favour of that cours[illegible] covered receptacle were used.

Mrs. Dacre Craven said the remuneratio[illegible] by dustmen was an obstacle to their empl[illegible] poor people often let their dust and refuse [illegible] for two or three months. Unless some la[illegible] passed on the subject of the removal of suc[illegible] nuisance, very little could be done to reme[illegible] ing state of things in that respect. The ai[illegible] ing poor houses was so vitiated by emana[illegible] the dust-bins, that they could not even obt[illegible] by opening their windows.

The meeting then adjourned for a repetit[illegible] Buckton's lecture at four o'clock, by expre[illegible] H.R.H. Princess Christian.

. OF THE SOCIETY OF ARTS.

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FRIDAY, JULY 15, 1881.

...tions for the Society should be addressed to the Secretary
John-street, Adelphi, London, W.C.

NOTICES.

CHAIRMANSHIP OF COUNCIL.

...day last, the 11th inst., at their first ...he Council elected FREDERICK J. BRAM- ...'.Inst.C.E., F.R.S., as Chairman for the ...ar. The various committees were also ...ed.

EXAMINATIONS, 1881.

...of successful Candidates in the Examina- ...ne present year has been printed, and is ... to the Institutions in Union with the ...mber of the *Journal*. Copies will also be ... various Local Boards for the successful ...

...EDINGS OF THE SOCIETY.

CANTOR LECTURES.

WATCHMAKING,

By Edward Rigg, M.A.

LECTURE I.—*Continued.*

...rrenness of the last hundred years in ...l invention is in striking contrast to the ...the century which preceded it. In 1680, ...ce-spring was but recently invented, ...nd Sully were just born, Huyghens and ...re still in the prime of life. In 1780, we ...ssessed the dead-beat clock escapement ...us compensation pendulums, Arnold's ...ons of the chronometer escapement, ... balance-springs, compensation balances, ...and cylinder escapements, in fact, all the ...lines of our timekeepers of the present ...ve desire to see what progress has been ...e that date, we can only seek it in a ... proportioning of the several parts, an ... production, a more exact workmanship, ...re scientific knowledge of the laws by ...ekeepers are governed. With but few ..., the improvements effected in the time- ...roperties of watches have not resulted ...stigations made with that object in view, but as a necessary consequence of their resemblance to the chronometer.

One fact, however, in partial explanation of this absence of change, suggests itself. Amongst the earliest application of the mechanical arts was the construction of machines for the measurement of time, and a perusal of the older treatises shows how much ingenuity was devoted to them. Thus it happens that horology was at an early date in a comparatively high state of development, and was not in the same need of radical changes as were most of the other arts of construction. It may further be added that the results attained, as regards timekeeping, have been eminently satisfactory, so that the arguments in favour of a change of system must be based rather on facility and economy of manufacture. These latter, as will be seen from the next lecture, are now forcing themselves on our attention in a manner that they have not hitherto done.

In the preceding historical notice, I have had to refer to many subjects doubtless unfamiliar to some of you, but it did not seem desirable to prolong this branch of the subject by the addition of explanations, that can be better given in the course of the more detailed consideration of the pocket watch, upon which I now propose to enter.

A watch consists essentially of three parts—(1) the driving mechanism; (2) the controlling and regulating mechanism; (3) the indicating mechanism. Fig. 10 (p. 674) represents the mechanism of a full plate watch, or of a marine chronometer, the top plate, together with the escapement, having been removed.

The barrel contains a coiled spring to serve as a motive power, and is connected by a chain with the fusee, which serves to render uniform the force transmitted to the train. From the figure it will be seen that, as the watch is wound up by a key on the fusee axis, the chain is unwound from the barrel and wound on to the fusee, which may be defined as a screw of rapidly diminishing diameter. When the spring is fully wound up, and therefore exerting its maximum force, it acts at the extremity of the shortest power arm, or radius, of the fusee, and this arm gradually increases as the force exerted diminishes. Within the fusee is the maintaining power for keeping the watch in action during the time of winding. The centre wheel, whose pinion is driven by the fusee, carries the minute hand, and engages with an intermediate or third wheel. This drives the fourth wheel, on the axis of which is the seconds hand, and the escape-wheel seen in the middle of the figure is driven by the seconds wheel. The axis of the centre wheel below the plate carries, friction-tight, a pinion of twelve leaves, which, through a wheel and pinion of 48 and 14 respectively, drives a wheel of 42 teeth concentric with itself. The relative rates of these are as 1 is to 12, so that the hour hand travels 1-12th as fast as the minute hand.

The maintaining power seems to have been first introduced by Harrison, in 1736. Fig. 11 (p. 674), although not strictly accurate, will serve to explain the principle on which it acts. The mainspring causes the fusee to rotate in the direction of the hands of the watch, or towards the right. It will be evident, then, that, if the fusee and its wheel were solid, the pressure of the hand in winding, which turns in the opposite direction, would neutralise this motive

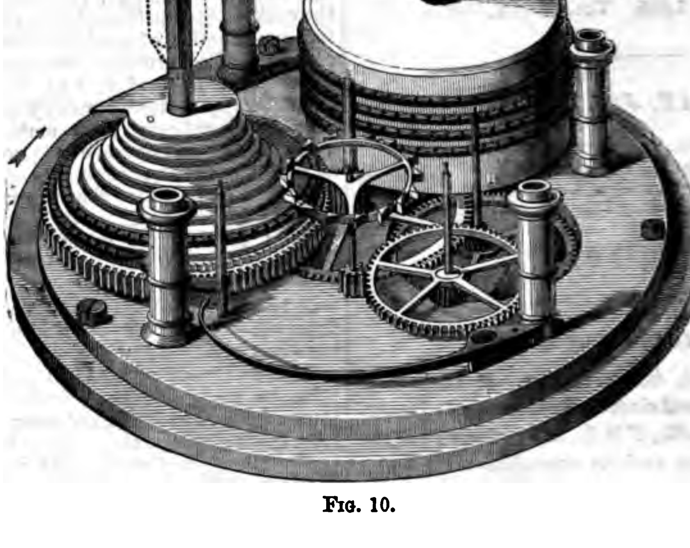

FIG. 10.

force, and the watch would stop. Such an inconvenience is prevented by the maintaining power. The brass ratchet wheel in the centre is rigidly fixed to the under side of the fusee; side by side with it, and loose on the same axis, rotates a steel wheel provided with very fine ratchet teeth, cut in the opposite direction to those of the brass ratchet wheel, and carrying two clicks held by springs against this latter wheel. A detent fixed to the plate engages with the ratchet teeth of the steel wheel, and the brass fusee wheel below, which is not represented in this figure, but will be noticed in Fig. 10, communicates motion to the train. A recess in this wheel contains a flat circular spring, indicated by the shaded portion of Fig. 11, one end of which is attached to the steel wheel, and the other to the brass wheel.

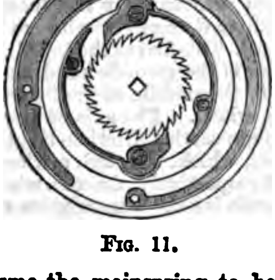

FIG. 11.

Now, assume the mainspring to be wound up. The fusee, with the brass central ratchet attached, tends to rotate to the right, and, through the clicks, communicates the impulse to the steel wheel; this impels the fusee wheel, at the same time maintaining the circular spring compressed. While the watch is going, then, the teeth of the steel ratchet pass freely under the detent. But consider what occurs when the fusee in the opposite direction, during the act of The brass ratchet passes under the clicks steel one is locked by the detent. The spring, therefore, maintains its constrained the end attached to the steel ratchet b stationary: its elastic force is expende tinuing the impulse on the fusee wheel action will be maintained for a period c on the extent to which it has been comp

Reference has already been made to so in which the ordinary Swiss watch di that of English make. I would only her the suppression of the fusee, whereby the ing power is rendered unnecessary. T barrel is provided with teeth, whic directly with the pinion on the axis of t wheel, and, in winding, the inner end of spring is coiled on to an arbor in the cen barrel; the barrel, therefore, is const revolve in the same direction as by t during its uncoiling. Hence there is, a continual movement of advance of th whereas, when a fusee is used, one e spring always remains stationary, and it uncoils about the same mean position.

This distinction causes the first to be c a going barrel, and it is gradually co more general use, in watches other than trolled by the cylinder escapement. The put forward for and against each form are very numerous, and I shall prese more specially to the question, as it co main distinction between the ordinary E the continental or American watches; i regarded as the essential point on whic and foreign horologists differ.

The bearings of the question as to wh suppression of the fusee is desirable or however, be better appreciated when th ments commonly used in watches hav

ined, as the degree of uniformity required in motive power will necessarily depend on power of the escapement to neutralise its gularities, a power which varies considerably.

n escapement, it will be understood, is an liance adapted to the end of a train of wheels rder to prevent a too rapid motion, and at the e time to regulate the expenditure of the motive e in such a manner that it is allowed to exhaust f with the requisite slowness and uniformity. variety among escapements is very great; y are suitable for stationary timekeepers, e being quite unfitted for such as are con- tly moved about; some are adapted to the movement of a pendulum, but cannot be loyed without modification with a balance. e ordinarily met with in watches, and which I shall briefly consider, are five in number, erge, cylinder, duplex, lever, and chronometer, tent escapements. Let us take them in the r here given.

e verge escapement was the first employed mekeepers, having been invented sometime een 1000 and 1400 A.D. It has been assigned ohn Megestein, a clockmaker of Cologne, in ourteenth century, and was the only escape- known up to the middle of the seventeenth ry. An early form is shown in Fig. 1, on 666, from which it will be seen that a vertical suspended at its upper end and terminating in rot, carries two pallets that engage with a n wheel having ratchet teeth, and to the r end of the rod two horizontal arms are , that support equal weights. The pallets are ed at an angle of about 100° to each other, it will be seen that if a motion of rotation is to the wheel, its teeth will alternately ge with the pallets, and impart an oscillatory on to the system. By moving the weights rds or from the centre, the period of this lation can be varied, and the rate of motion of rain of wheels thus regulated. If a balance fixed weight be substituted for this folliot, own in Fig. 2, on page 667, and the whole pported between two pivots, it will be seen such an escapement is portable, and, further, sesses the property of continuing to go, even ugh unprovided with a balance-spring, as the case until the seventeenth century. ks to the kindness of Dr. Longton, of South- I have here such a watch. It bears the name of David Lestourgeon, of Rouen, and possesses special interest, both on account of its being unpro- vided with a balance-spring, and owing to the fact that a catgut band is employed in place of the well- known chain on the fusee. Its date is probably about 1640. All its parts appear to be original, and the watch is still in going order.

The principle of the verge escapement is met with in Sully's marine clock, already described, and elsewhere, and the celebrated French horo- logist, Berthoud, had an extraordinary fond- ness for it. There is no question that very good results have, at times, been secured with the verge, but to obtain them requires all the ability of the most skilful workman, and his time is far better employed on the superior class of escapements. A main objection to it consists in the fact that, the motive force being always applied to the balance, any slight variation in this force causes a change in the rate; hence a very carefully adjusted fusee is essential, and the adjustment must be corrected whenever a new spring is fitted. The working parts are subject to rapid wear, and the use of an escape-wheel, in a plane perpendicular to the plates, renders a thick case necessary.

It is worthy of remark, that the objections to a verge escapement in a watch, do not apply with nearly the same force in a clock; and the common "Comté," Dutch, and other clocks are known to be fair timekeepers. This difference arises from the fact that the arc of vibration is so small; and M. Wagner has proved experimentally that the verge is all the more capable of giving accurate results, as the oscillations are made shorter.*

To turn to the brief consideration of the cylinder, Geneva, or horizontal escapement. As already stated, it was invented by Graham, in 1700, and, for a reason that will soon appear, it is classed by Saunier as a "frictional rest" escapement. Fig. 12 represents an inverted plan of the escape-wheel teeth and cylinder, and Fig. 13 (p. 676) is an ele- vation of the entire escapement also inverted. The upper portion of the cylinder carries a brass collet, to which the balance is rivetted, and the cylinder itself is a steel tube, half of which is cut away throughout a portion of its length, and three- quarters through rather less than half of this portion. The wheel is provided with teeth pro- jecting downwards from the plane of the paper in Fig. 12, and terminating in triangular formed heads.

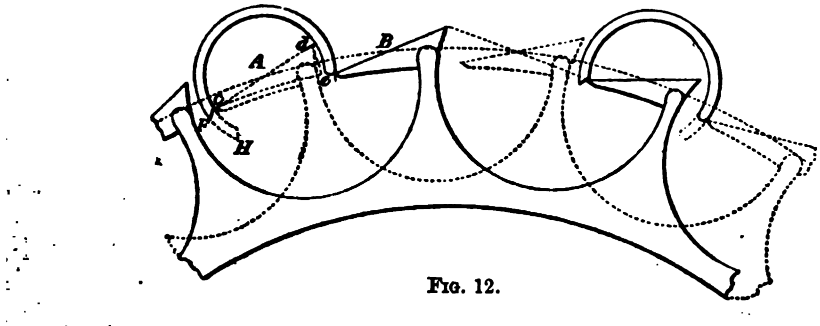

FIG. 12.

ccessive positions of the cylinder in relation oth are indicated in Fig. 12, the wheel being led in the direction from right to left. A , B, coming in contact with the edge (e) of the cylinder, A, causes it to rotate in the direction opposite to the hands of a watch until the heel of

* Saunier, "Treatise on Modern Horology," p. 67.

B escapes from the edge, and its point falls against the inside of the cylinder at c. The cylinder and balance continue to rotate through the impulse that has been communicated to them, until they are

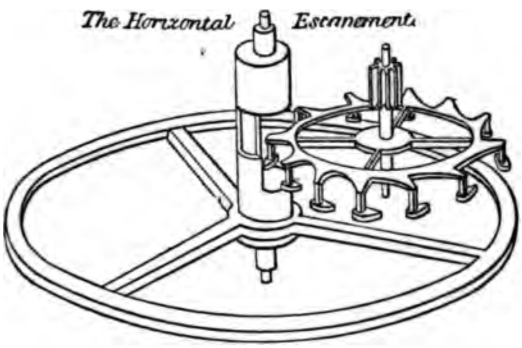

Fig. 13.

brought back by the action of the balance-spring. Rotating now in an opposite direction, the tooth is released from the inner surface of the cylinder and gives a fresh impulse against the edge, H, as soon as it reaches the point, F, and when the tooth, A, is released, the next tooth falls against the outside of the cylinder; the balance-spring now brings the whole back again, and a similar series of actions recurs. The reason for the distinctive term, "frictional rest," will now be evident. It refers to the fact that, during the entire period the escape-wheel is at rest, there is friction occurring between the point of a tooth and the inside or outside surface of the cylinder, and this friction, slight though it apparently is, is a most important feature of the horizontal escapement; for if, from any cause, the motive power increases, the pressure of the point of a tooth on the cylinder increases proportionately. The friction therefore increases, and the watch goes slower. There is thus a kind of natural adjustment that more or less exactly makes up for variations in the motive force—indeed, it was observed by Jodin more than a century ago, that if the balance is too large, the watch goes slower with an increase of the motive force, and, conversely, when it is too small, it goes faster. It will thus be seen that this escapement possesses one important advantage over the verge: it does not necessarily involve a uniformity in the motive force.

With a view to diminish the friction and wear of the cylinder, it has been made entirely of ruby, but such a construction is difficult and costly, and the rate obtained is not superior to that with a well-made steel cylinder. I shall not, therefore, stop to further describe it in this hasty sketch of the escapements in ordinary use.

The first idea of the duplex is attributed to Dr. Hooke, who employed a two-balance escapement in the watch he designed, in 1660, for Charles II., a watch that possesses considerable interest as being the first to which a balance-spring was applied. It was, however, materially modified by Dutertre, P. Le Roy, and Tyrer, the latter of whom gave it the form shown in Fig. 14. The escape-wheel is provided with two sets of teeth; a long pointed series, whose office it is to arrest the movement of the train immediately after locking has been effected by the balance series of triangular teeth projecting upwa the flat of the wheel, by which the im

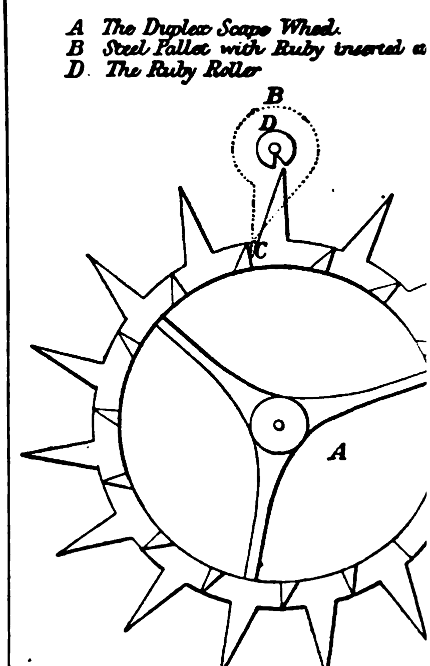

Fig. 14.

communicated to the balance. In t forms of this escapement, there were t on one and the same axis, but its princ course the same.

The axis which carries the balance ar spring is at D. It also carries a small tube of ruby, in which a notch is cut Above the roller is a steel arm, B, pro a ruby pallet, C. The axes of the b escape-wheel, A, are so pitched that th the resting teeth, although being held surface of the ruby roller, do not reach of the notch in it (in the figure they engraver's mistake, set too far apart). represents an impulse to the pallet together with the balance, will continu in a direction opposite to that of the watch, i.e., from right to left; during t tion the resting tooth will remain against On the balance being brought back by its escape-wheel will remain stationary, ex the resting tooth drops into the roller not the spring brings it back a second time, al assume the positions shown in the figure, impulse is applied. From the above expl will be seen that the duplex resembles th escapement in having a frictional rest; b friction occurs at a greater distance escape-wheel axis, and a less distance fr the balance, its effect in reducing the motion of this latter is proportionately this friction must have a certain in enabling the escapement to neutralise va

motive force, as in the one last considered; the two further resemble one another in possessing a kind of natural compensation for variations of temperature. In both, the points of the teeth require to be provided with oil. Now, it is known that in the cold the elastic force of a balance-spring increases, and it has a tendency to accelerate the rate. But cold will also increase the consistency of this oil, and, therefore, the friction or, rather, the adhesion; thus, to some extent, counteracting the accelerating effect of the spring. Though it would be too much to pretend that the two influences always neutralise one another, the effect is sufficient to render a compensation balance far less essential than it is in detached escapements, such as the lever and detent; indeed, it would be inapplicable, on account of the variability of this adhesion with time.

The duplex is unquestionably a beautiful device, and capable of securing very uniform timekeeping, but accurate workmanship is in the highest degree essential. For this reason, and owing to the fact that it is liable to be disturbed in its action when carried, the duplex is considered less satisfactory than the lever, which, for the same degree of ability on the part of the workman, secures a better rate.

There are many varieties of the lever escapement, but that most frequently made in England, and known as the English lever, is shown in the diagram (Fig. 15). This escapement is by far the best that

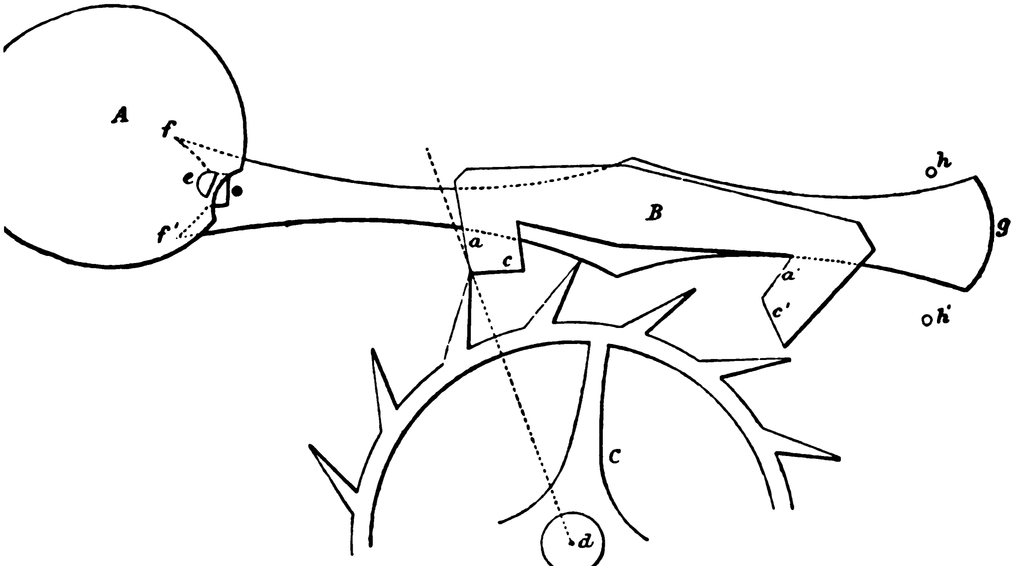

FIG. 15.

yet been devised for portable timekeepers, and rapidly displacing all others, even the cylinder; we already referred to some of its earlier forms. The arrangement adopted by Mudge, in place of rack and pinion of Hautefeuille (Fig. 8, p. 670), somewhat difficult of construction, and has since simplified, but the principle remains precisely the same. Indeed, it is worthy of note that in the improved form of the lever escapement, known as double roller, we have a remarkably exact copy of Mudge's original design.

In the ordinary English lever the balance is fixed on the axis, A, on which is also a steel discs roller, carrying a semi-circular ruby pin, *e*, and away in crescent form, as indicated. The impulse is communicated by the escape-wheel teeth to two faces, *c* and *c'*, of the "pallets," which are fixed to a light steel lever, *eg*. At the extremity of this lever is a notch, into which the ruby-pin enters during its rotation, and a brass pin, indicated by a black dot, and termed the "guard-pin," whose use will be presently evident. Consider the several parts in the positions shown in the diagram, and the balance rotating to the hands of a watch. The ruby-pin, *e*, having just entered the notch, lifts the end of the lever, and releases the tooth from the locking face, *a*, of the pallet, *a c*. In traversing this pallet, the tooth will communicate its impulse to the lever, and the ruby-pin will be impelled forward by the lever side of the notch, until, when the lever rests against the opposite pin, *h'*, it escapes from the notch, and during the remainder of the vibration the balance is entirely detached. The tooth falling against the locking face, *a'* will maintain the lever stationary, but, in order to avoid any accidental displacement, the guard-pin near the notch, already referred to, is added. This is almost in contact with the roller on the axis, A, so that the lever cannot leave *h* or *h'* except when the guard-pin is opposite the crescent in this disc, in other words, when the ruby-pin is receiving its impulse from the notch in the fork. The elasticity of the balance-spring causing the return of the balance with the attached roller, the ruby-pin will again enter the notch, travelling in an opposite direction, and will receive a further impulse from the tooth acting on the pallet, *a'*.

It is very usual, both here and abroad, to distribute the incline between the teeth and pallets, and some makers have transferred the inclines entirely to the teeth, giving the pallets the form of English escape-wheel teeth. The principle of the escapement, of course, remains the same, whatever form is adopted, and good

results have been obtained from all. It cannot be denied, however, that the pointed teeth are less made than formerly; they possess advantages in that they allow more oil to be retained on the surface of the pallet, and are more easily made. On the other hand, with club teeth the friction is distributed between two points instead of one, the oil is retained on the acting surfaces better, and the drop, or distance travelled by the wheel between leaving one pallet and reaching the other, can be reduced indefinitely.

The club-tooth has been generally adopted in factories for ordinary watches, and it is unquestionably less liable to damage by rough usage, but its adjustment is said to be more difficult, and for equal accuracy in timekeeping at moderate cost, it seems doubtful whether the ratchet-tooth is not to be preferred; it will certainly be less influenced by variations in the thickness of oil. But both forms possess special advantages, and the selection must be left to experience. Just as there are varieties in the wheel and pallet action, there are varieties in that of the fork and roller; but, having described that most commonly met with, I must not spend more time in their consideration, as they possess no special features of interest.

It remains for us to briefly consider the chronometer or detent escapement, as it is occasionally employed in pocket watches. Although it is without question by far the best for the marine chronometer, many competent horologists maintain that a mistake is made when this escapement is used for watches, as its action is liable to be disturbed by shocks; so that, while more expensive than the lever, it is, for a watch, not superior to it as a timekeeper. The detent escapement was devised by P. Le Roy, and applied by him to a marine chronometer in 1766. Its form was, however, modified by Berthoud, Arnold, Earnshaw, and Breguet, so that its present form cannot be claimed by any single inventor. The design usually met with is shown in the diagram. At F is the axis of the balance, which is, as in the previous cases, omitted in order to avoid confusion. On this are carried two steel discs, F and E, in which ruby pallets are fixed. A is the escape-wheel, one tooth of which is represented locked against a ruby, *b*, carried on a spring arm, B *b*, to which a very light gold spring, D D, is fixed. Consider the balance to rotate in the direction of the arrow, the pallet in F will merely raise the spring, D D, out of contact with the extremity of B *b*, and the balance will continue its movement until arrested by the action of the balance-spring. In the return vibration, the pallet, instead of merely raising D D, will force the entire piece, B *b* D, towards the right, releasing a tooth of the escape-wheel. A tooth will immediately fall against *e*, and communicate the impulse to the balance, and the spring will fall back into its place by its own elasticity, arresting the movement of A. The balance, then, receives one impulse for each double vibration, and in this respect the escapement resembles the duplex.*

Having now briefly described the more important escapements met with in portable timek
will be well to say a few words in regard
relative merits. The first three descri
verge, cylinder, and duplex, are always u
influence of the motive force, whereas, in

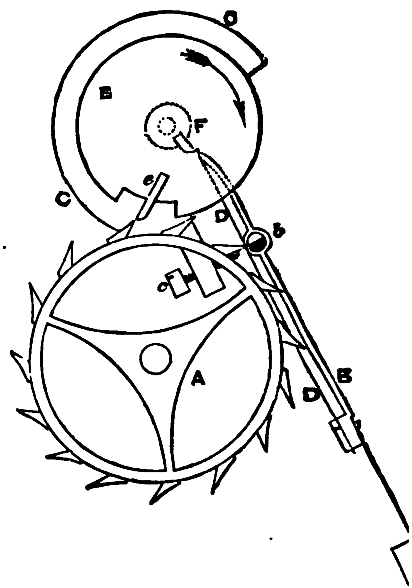

Fig. 16.

and detent escapements, the balance is onl
during brief intervals to unlock the esc
and receive the impulse.

Now, in every well made balance-spi
viding it be of sufficient length, there is
that possesses the property of isochr
virtue of which all the vibrations of an
balance, of whatever extent, within
limits, are performed in equal intervals
and an isochronal vibration is charact
the fact that the force exerted by th
is always proportional to the angle throu
the balance is turned from its position of
in every form of escapement there is
during which the balance receives its
when the character of the movement is su
as to be destructive of theoretical isochro
however, this is a regular influence occ
each vibration, it is quite possible to tal
account, so long as it does not vary beyo
rate limits, and thus to secure practical iso
But if the impulse varies beyond these li
vibrations are no longer performed in equ
and hence we see why it is that in the l
detent escapements a very near approach
formity in the motive force is essential.
variations in this force gradually incr
difficulty in adjusting the isochronism w
portionately increase until a point is
beyond which it becomes impossible. Th
larity in the restraint put upon the bal
cylinder escapement renders an isochron

* The mode of action of the detent escapement was further illustrated by means of a beautifully-executed working model, for which the lecturer was indebted to Mr. S. Jackson; and that of the lever escapement by a similar model, kindly lent by Mr. Tripplin.

ense, and the same may be said in a
f the duplex.
siderations lead me to refer more
to that much vexed question as to
is advisable to retain the fusee in the
ch, seeing that it has been abandoned
ther watch-producing country. I
hink that, in writing on this subject,
makers have missed the real point at
at the advocates of both views have
eir side. In the first place, it is no
t of high-class timekeeping to observe
nly at intervals of say, 24 hours,
al period elapses between successive
p. Absolute coincidence with the
der such conditions only shows that
uring the first 12 hours, when the
of the mainspring were in action, was
y a loss during the last 12 hours. Let
, consider a going barrel and fusee
while being wound up every 24 hours,
ually good rate when examined at
12 hours, all question of compensa-
perature being of course eliminated by
them at the same degree of heat, the
being the same. The motive force
g barrel is certainly less constant than
see [a fact which was practically
d by means of a lever, with a sliding weight, fixed to the winding square of a fusee watch and of a going barrel watch successively, the escapement being in each case removed. It was shown that each turn of the fusee was able to lift the lever without altering the position of the weight; but, with the going barrel, this weight had to be gradually moved towards the centre, to correspond with the decreasing motive force]. As we have seen that the adjustment of the isochronism becomes more difficult as the variations in the impulse become greater, the conclusion to which we are forced is that more skill has been required to adjust the going barrel watch. It is obvious that the amount of variation in the arc of vibration depends on several conditions that may be more or less favourable. M. Philippe found,* as the result of a great number of experiments on going barrel watches, that this variation varied from 112° to 65° in 24 hours according to the form of spring and the mode in which it was fixed in the barrel, but he does not state the extent of the initial arc. The curve in Fig. 17 exhibits the results of experiments made by M. H. Robert† on the same subject. He found that, by increasing the motive force in one of his going barrel chronometers from 300 grammes to 2,500 grammes, the arc of vibration increased gradually but not uniformly from 135° to 490°. Mousquet,‡ in discussing these results, directs attention to the remarkable fact that, if we take

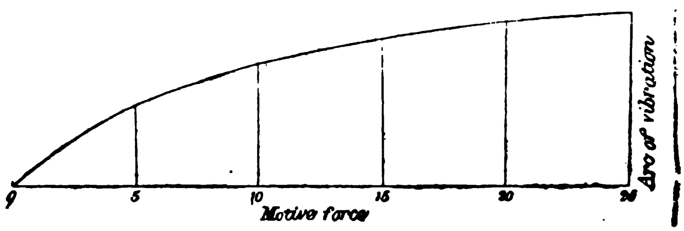

FIG. 17.

of the efficacy of the impelling force
f the arc of vibration divided by the
we shall find a maximum at the point
g to 370° arc of vibration, and a
of 1,300 grammes. Of course, this num-
ced by a great variety of circumstances
ith the construction and design of the
, so that it cannot hold good in all
he subject is well worth investigating
a number of chronometers of different
there seems good reason to suppose
l afford a datum for determining by
the most advantageous motive power
case.
de with this curve of M. Robert's, I
two curves, Fig. 18, representing the
nge in the strength of mainsprings on
ell-known principle of the indicator
hey are selected from a number given
ier,* and the upper curve, B B, refers
for a watch going 15 days, while the
A, belongs to that of an ordinary
of the same general dimensions, and,
with a going barrel. A few words
o explain the mode in which they are drawn. Heights measured on the equi-distant vertical lines represent the force of the spring, and each of the equal horizontal spaces corresponds to one complete turn of the barrel. Thus, the diagram

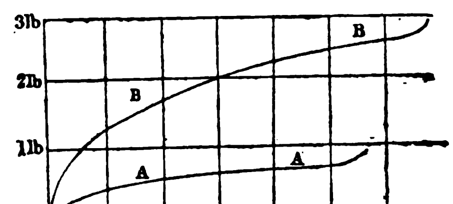

FIG. 18.

shows that spring, B B, makes about 7 turns, and A A makes only 5½. Assuming 5 turns of B B to be used in the course of the 15 days, we see that the impelling force will vary from about 2·6 lbs. to 1·3 lbs., so that if its initial arc of vibration was 370°, its final arc, judging from Robert's curve,

reatise on Modern Horology," p. 670.

* "Journal Suisse d'Horlogerie," II. (1878), p. 201.
† "Revue Chronométrique," I. (1856), p. 102.
‡ "Revue Chronométrique," II. (1858), p. 216.

will only be about 275°. The one-day spring is characterised by the same degree of variation. Assuming four turns to be brought into action, the initial impelling force is 0·7 lb., and that at the end 0·35 lb., so that, with the same arc when fully wound up, it will fall to about 275°. This spring, A A, is evidently a good specimen for a going barrel watch, as may be judged from the flatness of its curve, and yet its isochronal adjustment will require to be correct, through a range of at least 100°.

I have taken the maximum arc of 370° as being that to which the investigations of M. Mousquet point as the best. It is, however, important to remember that they can only be regarded as applying to the particular watch or chronometer of M. Robert's that he is discussing, and in any other watch a different angle would probably be found to correspond to this maximum effect, dependent on various conditions as to the escapement, &c.

I must not omit to mention a further important advantage, secured by rendering the motive force uniform by the aid of a fusee. Probably the most neglected adjustment in a watch is that which is necessary in order to ensure an equal rate in varying positions. When lying flat the friction is, as a rule, less than in a vertical position. The rate is therefore seriously modified by the change, and, on altering the position of the watch in a vertical plane, the rate is subject to still further modification, mainly owing to the influence of gravity. It would be of no general interest to attempt a discussion of this question, but I will only add, that, if the motive force is not approximately uniform, the requisite adjustment becomes almost impossible.

The additional cost of a fusee is so slight as not to be worth considering, and it seems fair to conclude that, if in such high-class watches the fusee and chain are abandoned, additional care and skill must be devoted to the isochronal and other adjustments, and there will be an increased risk of derangement in the cleaning, &c., by any but the most skilled hands. The number of springers competent to undertake the best work is already so limited, that it seems most unwise to risk further reducing their number by increasing its difficulty.

It will be understood that I have hitherto spoken only of the very highest branch of the watchmaker's art. Whether the fusee should be retained in ordinary watches—watches, that is, which have to compete with foreign produce—involves other considerations, which I hope subsequently to refer to. But it will be a matter of regret if, in the highest branches of the watch trade, the fusee is abandoned in favour of the going barrel, as we have it in the present day. I have not seen that any advocates of the fusee in the recent discussions have drawn attention to the fact that Henri Robert, a strong advocate of the going barrel even for chronometers, urged that the fusee should be retained in high-class watches,* because the space available for the barrel is limited, and it is therefore impossible to employ a mainspring with 10 or 12 turns, as in his marine chronometers. There have been few such earnest advocates of the going barrel as M. Robert, and his testimony in favour of the English practice is therefore of special value. And he is far from being alone in this matter. It has become the fashion at the present day to upbraid English makers for retaining the fusee; but if anyone will study the horological literature of the Continent, he will be surprised to find how many of the best known authorities are favourable to its retention in the case of high-class watches. Besides affording a ready means of equalising the motive force, the fusee possesses yet another very important recommendation. If an ordinary mainspring be fully coiled up in a barrel so as to "choke" on the arbor, forming, as it were, a solid block, and then allowed gradually to uncoil, the inner coils will remain in close contact, and the outer [illegible] will be the first to release themselves. Thus the motive force due to such a spring will, through the greater part of its uncoiling, be modified [illegible] the adhesion between these coils, diminishing [illegible] the oil becomes thicker. The variability in [illegible] motive force is, then, itself a variable quan[illegible] Now, if instead of being of uniform thick[illegible]ness throughout, the spring be suitably taper[illegible] so that the thickness increases gradually [illegible] within outwards, it is evident that the [illegible] may all be caused to separate from the [illegible] for the tendency of the outer coil to exp[illegible] is greater relatively to the mean strength of [illegible] spring, than it is in the case of uniform thick[illegible] As all the coils are, therefore, apart through[illegible] the period of winding, the irregularity due [illegible] variable friction, &c., is, in great part, avoid[illegible] But such a spring could not be used in the go[illegible] barrel, since there is even greater variation in [illegible] force exerted as it runs down than in the ordin[illegible] —a fact which was prominently brought out [illegible] the experiments of M. Philippe, above refer[illegible] to. The correcting action of the fusee is, there[illegible]fore, the more requisite.

The difference in the mode of unwinding of [illegible] two forms of spring, is exemplified by the [illegible] Figs. 19, 20, and 21 (p. 681). The first of these [illegible] a mainspring fully wound up, so that all the [illegible] are in close contact. A spring of uniform thick[illegible] begins to open out in the manner indicated [illegible] Fig. 20, and must evidently occasion a [illegible]siderable variability in the motive force owing [illegible] adhesion. The tapered mainspring, as used in [illegible] best English watches, will open out somewhat [illegible] the manner indicated in Fig. 21, so that the [illegible]fluence of adhesion is in great part avoided.

The fact that the fusee is of such value [illegible] serve as a stimulus to the invention of improve[illegible]ments in the going barrel, for there certainly [illegible] real objections to the ordinary form of [illegible] English watch, and a reliable going barrel, [illegible] secures an equally uniform transmission of [illegible] is much to be desired, as it would form a [illegible] point for the designing of a new calliper. [illegible] changes have been suggested with which, [illegible]ever, I will not now detain you, and more [illegible]tions have been proposed in the escapement [illegible] account of the variability in the motive force [illegible] from any other cause; but none of these ha[illegible] been permanently and completely successful, [illegible] compared with a well-constructed fusee and [illegible] Many of the objections so persistently [illegible] against this construction, though well deserve[illegible]

* "Revue Chronométrique," vol. i. (1856), page 109.

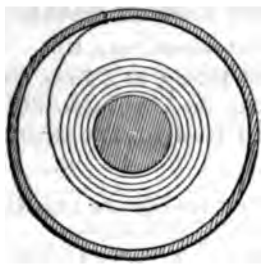

FIG. 19.

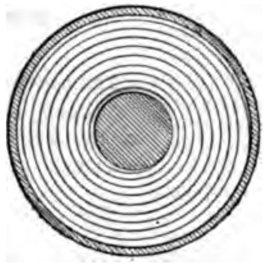

FIG. 21.

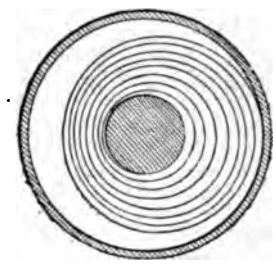

FIG. 20.

se of cheap watches, are utterly unreal as ls the well made and highly adjusted English . Thus, it is frequently asserted, that they ficult, if not impossible of repair by country nakers; but, I would ask, is a workman annot repair a fusee the proper person to rusted with a highly adjusted watch at all? ing now considered the precautions that are with a view to avoid or neutralise variations motive force in a watch, it remains for me a few words in regard to the other principal of irregularity—variations of temperature. who desire a fuller discussion of the question fer to a paper which I read before the Society s, in March, 1879, on "Compensation."*

m the temperature of a balance-spring is d, its elastic force becomes greater, the ions are therefore performed quicker and the gains; the converse is the case when heat lied. Now the period of vibration of a e depends on the distance between the axis ation and the rim, varying directly with this ce, so that if the radius can be reduced in a r exactly corresponding with the reduction elastic force, the rate will, theoretically, n the same at all temperatures. Such an ite adjustment has not yet been secured, but close approximation has been reached, and lance shown in Fig. 9, p. 671, is sufficient for cket watches and is universally used. It will n that the rim, instead of being a continuous of brass, steel, or gold, is formed of two s, brass and steel, with the former on the e, and it is cut through in two places. gold screws are inserted at intervals round im, and the principle of its action is as rs:—The expansion of brass for a given f temperature is greater than that of steel; mposite arm, then, will become more curved heat is applied, and the free extremity will inwards towards the axis of the balance, ing with it of course the gold screws. Thus ction is equivalent to a reduction in the ter of the balance since the greater portion weight is brought in towards the centre, he adjustment of the compensation consists y in so placing the screws that this effect be proportional to the change in the elastic of the spring. Many other forms of balance been suggested for use in chronometers, but me described is almost exclusively used in es, and secures a very high degree of regu-, if properly adjusted. But by no means all watches provided with these balances are so ted, and in very many cases a good plain balance is to be preferred, especially in a moderate priced watch. At the same time it is probable that a well-proportioned compensation balance with cut rim, that is unadjusted, will do something in the direction of counteracting the effect of variation of temperature, an effect that, according to Delamarche and Ploix,* amounts to about 11 seconds per 24 hours per 1° C.

The compensation balance, like the isochronal spring, is not equally applicable to all forms of escapement. Thus the verge is subject to such variable influences that the irregularities due to temperature are only a few of those to which it is liable; the cylinder and, to a less extent, the duplex, have a natural power of compensation, as already explained, just as they have a natural isochronism. But, for reasons similar to those already given when speaking of isochronism, the lever and chronometer escapements in their highest perfection require it.

Hasty though this account has been, I trust I have said enough to indicate what intelligent and skilled work is required for the adjustment of a watch, even after all its parts have been properly constructed. The degree of perfection now attained to is, in a sense, more remarkable than that of the marine chronometer, for, besides being of smaller dimensions, it involves an additional and troublesome adjustment, that for position. The productions of some of our best makers are really remarkable for their accuracy, a watch that does not vary more than half a second in 24 hours, in different positions, being frequently met with. Now, as it is physically impossible to secure absolute perfection, I am disposed to think that this must be regarded as a near approach to the limit to be attained with certainty. In what direction then must future advance be looked for? There seem to be only two possible avenues. A more general distribution of high-class time-keepers and, as tending in that direction, a simplifying of their construction, and therefore a lowering of their cost of manufacture.

Watchmakers may be disposed to doubt the possibility of simplifying the English watch, but they should remember that the history of all radical improvements in machinery exhibits a tendency towards simplicity; where the converse appears to be the case, it will generally be found that a tool or instrument has been made more automatic.

With regard to the more extended use of high-class watches, I would refer to a practice much in vogue in Switzerland, which it is stated has greatly helped to extend the trade. I mean the testing of watches at an observatory, as marine chrono-

* "Journal of the Society of Arts," vol. xxvii. (1879), page 342.

* "Comptes Rendus," xlviii 241., (1859).

meters are tried at Greenwich, or thermometers at Kew. The rate-papers thus obtained have doubtless been in many cases utterly valueless and misleading, owing to the fact that the commonest watch may often be found to go with remarkable regularity for a limited period, but if the trials were continued for a sufficient length of time, under varying conditions, by a properly-constituted authority, they could not fail to be of great service, as affording reliable evidence of the degree of accuracy to which our best makers have now attained. Foreign competitors have found the advantage of such guarantees, and it is impossible but that they should be of use here. They might almost be compared to the hall-mark on a piece of plate, which affords a security that cannot be gainsaid, and is independent of the faith that the buyer may or may not have in the seller.

One other point, in regard to these rate-papers, which affords food for thought to English makers, and should, I venture to think, stimulate them to renewed efforts. Dr. Hirsch, the director of the Observatory at Neuchatel, publishes, in his annual report, a statement, showing the mean of the results obtained on watches submitted for trial. These results, for the last 15 years are as follows:—

Variation (in Seconds).

Year.	Daily.	Lying and Hanging.	Per 1° C.
1864	1·27	8.21	0·48
1865	0·88	6·18	0·35
1866	0·74	3·56	0·36
1867	0·66	3·57	0·16
1868	0·57	2·44	0·15
1869	0·60	2·43	0·14
1870	0·54	2·37	0·14
1871	0·55	1·90	0·13
1872	0·52	1·99	0·15
1873	0·62	2·59	0·15
1874	0·53	2·27	0·15
1875	0·46	1·97	0·13
1876	0·53	2·16	0·12
1877	0·51	1·98	0·11
1878	0·60	2·10	0·10

The general conclusion to which these figures point cannot be mistaken, and English makers may well envy their Swiss brethren the possession of so satisfactory a record of progress.

In concluding, I would refer to one other means by which the demand for high-class watches might perhaps be increased. As Mr. Ellis* has pointed out, the establishment of public clocks indicating seconds, besides being of very great convenience to chronometer-makers for testing their regulator clocks, may induce purchasers to become possessed of timekeepers of high quality, as they will have the means at their disposal of verifying their accuracy. The distribution of true time is becoming every day more general, so that we may hope this influence will be felt by the trade.

[The following blocks have been kindly lent to illustrate this lecture:—Fig. 1 (on p. 666) taken from Saunier's "Treatise on Modern Horology," by Mr. Tripplin; Figs. 10 and 11 are from Sir E. Beckett's "Clocks, Watches, and Bells" (Crosby Lockwood & Co.), 1874; Figs. 9 (p. 671) and 16 by the editor of the *Horological Journal*; and Figs. 12, 13, 14 by Messrs. Spon.]

* *Journal of the Society of Arts*, vol. xxvii. (1879), p. 358.

DOMESTIC ECONOMY CONGRES

(*Report continued from p. 672.*)

The meeting of Friday, 24th June, wa the Society of Arts, the Viscountess Str in the chair, and Lord Alfred S. Ch assessor.

Section D 1.—Rules for Health and Ma of the Sick Room.

Lady Strangford read a paper on "Teach of Health in Elementary Schools."

Sir Henry Cole said that nothing more simple, or convincing, even to Whitehall offi been read in the Congress. Lady Strang entirely proved her case, that a knowledg bodies would lead most effectually to the ac of other education in the shape of reading, wr arithmetic. The ladies of the Congress oug the Lords of the Council no peace until they them learn by heart Lady Strangford's paper

Mr. Chadwick recommended the formation for practical teaching in this direction, an account should be given of the working of it. forth mere generalities was not sufficient, and to be of any value should be proved and tried. acquainted with a lady who had laid down allow no colds in her house, and her reso course, entailed care on her part that the ser members of her household should not remai in damp clothes, and that all other induci should be prevented.

Sir Henry Cole thought if women would con households by laying down such rules as should be banished, and could carry them method, we should have gone very far in direction.

Paper read by **Miss Mary Martineau** on " the Laws of Health in Schools."

Mr. Chadwick said knowledge so exceedi should be particularly addressed to the super rities, because even in the construction of t schools, a great deal of information was war the subject. The very structure in which conducted their deliberations, and which ha large sum of money, had proved to have bee in violation of sanitary laws, and a lady me recently made very ill from sitting over a ve grating in communication with an old sew had been allowed to remain there. Needles the defect was soon remedied, and the sewe up. Evidently, a body so unacquainted with of health, required considerable instruction. schools connected with that body, where he filthy children massed together, in defiance of rules, the cases of sickness reached 30 per cen in another, conducted in accordance with the health, the per-centage of illness was only 10 p

Paper read by **Miss Pechey, M.D.**, on " Rules of Health in Elementary Schools."

Mrs. Sutherland Orr's paper, on the "Desir Introducing a Practical Knowledge of the Health in the Lower Standard of School Board tion," was read by **Lady Strangford**.

Mrs. Priestley entirely concurred in the pape really embraced her own idea that the subject much elaborated with science to be of any real use. If we could divest our views and, teaching of a good deal of science with, wh were mingled, more practical results would be It was, after all, a very simple matter, and taught in the simplest manner, especially to chi

Cole quite agreed that too much science d in teaching children from seven to ten

t thought a recommendation should be Education Department to put forward a irst extra subject in boys' schools should , just as the first extra subject in girls' . be domestic economy. Two extra sub- taken in all schools under the Depart- never heard of French and Latin been een suggested.

'ole said that they were so taken.

t thought possibly a particular reason r that in London just as in Kidderminster, ght drawing, because it would afford them aining a good and respectable livelihood, being much in request by the manufac- own. Certainly no subject could be taken estic economy. One necessity for teach- y was the great expense of diagrams, for ext-books, though they enable teachers to pectors, could not bring the matter home 1. Prizes and certificates might be given rashing, and other branches of domestic men would soon learn to look out for the wives among the young women who held s.

y of Alderley had had a long experience of aching, and had as far back as 18 years ago of girls in the country on physiology, and ed the interest they took in the dissection the village butcher, at her instance. She ight in St. Luke's parish, London, and to obtain animal specimens, she recom- upils to notice ligaments and tissues of xposed in the butchers' shops. She had r children at home, and had in all cases hildren take a great interest in these asily understand them. It was often said dren were inferior to those of richer people , but it should not be forgotten that they teaching by seeing their mothers handling od, which children in the higher classes 1, and she had found children of the lower cute.

ey knew something of the slums of burgh, and Leeds, and could speak to the f the working class of children. After ir intelligence toned down by their being . A rational basis should be given to he acts they were to perform, and when ation was given them, they were taught pidly.

Cole considered these subjects should not s extras, but as primary subjects. The unchangeable like the laws of the Medes and domestic economy might yet find before reading, writing, and ciphering. th Miss Peechey that the brightness and f women of the working classes were arriage, and the tyrant, man, was no doubt r it; but if boys were taught something of they might do more when men to alleviate of their wives.

r had seen in some of the towns of the s, classes taught by means of models, some ing given out for the children to say during 1 they were performing, such as making ing open windows with the object of im- eaching on their memories. Little things t way in youth were remembered in after h good might be done by the publication ses of that character compiled for the use

Mr. Pope said certificates were given by the Society of Arts, and he knew, as a lecturer, how they were striven for in classes. Every one of his ladies in an ambulance class had taken first-class certificates, but he was sorry to say the men had failed disgracefully. In these matters young ladies easily took the first place.

Mr. Edwin Chadwick maintained, as a fundamental axiom, that the home and the child were the chief domain of woman. If the tenour of the papers read by ladies at this Congress of Domestic Economy were fairly considered, it must be admitted that, on the whole, those papers were calculated to extend and vindicate that domain by their advocacy and demonstrations of the useful and the practical, as by living and applied science against the dead languages, and the theoretical and useless too long intruded by scholiasts.

Paper by Miss Louisa Twining, on "The Prevention of Disease," read by **Lord Alfred Churchill.**

Paper read by **Mr. Pope**, "Health in the School-room."

Madame Lofving said it was not sufficient to teach people the principles of domestic economy; they should be taught that they had within their own bodies organs for the performance of physical functions which were in themselves sufficient for the preservation of their health. As far back as 1830 that had been done in Sweden by Dr. Ling, and the State there soon took up the matter as one vital to the common weal. The Swedish military system was based on that gymnastic training, and another branch was medical gymnastics, for the cure and alleviation of injury and disease.

Mr. Chadwick had received testimony from officers in the Swedish Army that, by teaching the boys on Ling's system, it had been found that the period of service could be shortened, and that the actual force of the army had been largely increased. Even the Russians had adopted Ling's system.

Paper by **Mrs. Johnstone** (of Hastings), on "Prevention of Epidemic Disease," was read.

Mr. Chadwick pointed out that the essence of the paper was home treatment of disease where isolation was possible, as in the upper rooms of a house; and the possibility of avoiding contagion was shown by the fact that nurses often succeeded in protecting themselves for 20 years.

Sir Henry Cole said school-rooms ought not to be in so bad a condition as had been described by Mr. Pope, as the inspectors had power to report upon them when not up to standard; but the fault lay in the absence of a system on which to proceed. How imperfectly the inspectors' work was done was shown by the fact that in 1879 they had reported only four schools as teaching cookery, but this Congress had ascertained that there were no less than 300 in which that was done throughout the country. That kind of inspection was a work to which women alone could pay sufficient attention; and the members of the Congress should never rest until the education for home-life, which was the province of women, was provided for before the ologies were taught.

Lady Strangford made a few concluding remarks, and the meeting separated.

At the afternoon meeting, Lady STANLEY OF ALDERLEY occupied the chair, and the Rev. J. P. FAUNTHORPE officiated as assessor.

SECTION D 2.—THRIFT.

Paper read by **Lady Stanley of Alderley**, on "The Girls' Home Certified Industrial School."

Paper by Mrs. Townsend, "The Girls' Friendly Society," was read by **the Rev. J. P. Faunthorpe, M.A.**

Paper by **Lady Stuart Hogg**, on "The Metropolitan Association for Befriending Young Servants," was read.

The Rev. J. P. Faunthorpe, in inviting those present to join the Servants' Friendly Society, urged that servants should be encouraged to open accounts in the savings' bank as an important means of bringing about the reforms advocated. One way of inducing children—and possibly through them their parents—to begin to save was the distribution among them of post-office stamp slips.

The Rev. Mr. Long had spent a long time in India, and had had considerable experience in teaching and training women in the East. He had found that the great difficulty was always that insufficient attention was paid to the teaching of domestic subjects. The example of this Congress would not be confined to England, but would extend to the East; and no country more required to have inculcated among the people the principles here put forward than India.

Dr. Mann said that nothing too strong could be said in favour of the Girls' Friendly Society, and assured the members that they would be doing a good work by inducing as many as possible to join it.

Paper read by **Rev. W. L. Blackley**, on "National Teaching of Thrift and Providence."

Mr. G. C. T. Bartley, manager of the National Penny Bank, reminded the Congress that their object was not so much the laying down of principles on which the world was to be reformed, but to show, in a practical way, how children in schools could be taught to be thrifty. One of the best means of doing that was by giving a simple lesson in every school on the Penny Savings Bank, and on the Post-office Stamp Savings Bank. Post-office forms might be kept in schools, and stamps also, on which the children might be induced to expend their half-pence. Thousands would in that way be made thrifty. Children could easily be made to understand the principle of the savings bank, and they would soon begin to feel it a point of honour to have a little account there. That kind of work might be done with great advantage while waiting the arrival of the compulsory system shadowed forth by Mr. Blackley. Waste was a subject which was seldom looked after in schools, and very few teachers or children really understood its effects. Thrift was not necessary for the working classes alone, but for all. Children could easily be shown that waste damaged the person guilty of it and the community alike. Life assurance should also be explained, and could very easily be made intelligible by the teachers. This Congress should not make the mistake of carrying out anybody's special scheme of thrift, but should take care that simple practical instruction upon it was given to children in the schools.

Dr. Mann read a paper on "The Formation of Habits of Temperance among Girls."

Sir Henry Cole, without saying anything about temperance or intemperance, would revert to what was best to be done for teaching thrift in schools. Since 1847, the Education Department had made grants for the purchase of lesson and text-books; but they had in fact lost their soul, had no belief, and, as Sir J. Kay-Shuttleworth had said, "had become a mere red-tape administration of Parliamentary grants, by rigid rules, with the intention, above all things, of preventing the growth of the charge."

Lady Stanley of Alderley could not remain quietly by and hear the department disparaged, knowing how much had been done by it during the last fifty years.

Sir Henry Cole insisted that we had gone back within the last thirty years in our notions of how to teach children to be thrifty, and that result had arrived from our having got rid of all responsibility of advice.

Sir Walter Stirling was glad to see ladies so in this work, and that they had so efficient a l the Lady President. It was hard to expec without money to exercise the virtue of thrift. should have chiefly at heart to teach young gi do their duty, and to follow, even in househol the golden rule of doing to others as they wou by.

Mrs. Ross, in reference to the necessity of temperance in schools, gave an instance of an who, on asking the use of water, failed in a wh to obtain an answer that it was used to drink medical point of view they should be made with the fact that the drinking of small qu water was beneficial in cases of exhaustion.

Mrs. Charles read a paper on "Food-wast houses and District Schools."

Dr. Frances Hoggan read a paper on " of Effective Diet in Workhouses and Prison

Mr. Nunn read a few statistics from a re committee appointed to inquire into dietarie sons of England and Wales as to the cost o the quantities consumed.

Paper by Miss Preusser, on "Boarding ou Children," was read by **Mr. Tennant.**

Rev. J. P. Faunthorpe (as Assessor) co the members on having had the opportunity so many valuable papers as had been read, this would be a good omen that the Domesti as far as the Section "Thrift" was concerne be wholly fruitless. He referred in complime to Mr. Blackley's paper, and the practical made by Mr. Bartley, adding, that the latte was in error in supposing that this subj already taught in schools. Lady Stanl mendation that post-office stamp forms sh tributed among the children would l particularly valuable, and Dr. Mann's pape portant subject of temperance, bore closely and habits of the people. Too much impo not be attached to the desirability of sup Girls' Friendly Society, whose praiseworthy that young maid-servants coming from cou to London might find that they were not enti less and alone in the wide waste of the metr

Lady Stanley of Alderley, in addressing to a few concluding remarks, specially mention of the late Mr. William Ellis, who had fi the subject prominently before young peopl by his efficient style of teaching, much in he taught.

The Rev. Newton Price proposed a vote c Lady Stanley for her services in presidi Section.

Dr. Mann, in seconding the proposition, c tion to a small work published on the sul late Mr. Ellis, for use in schools.

The vote of thanks was passed unanimou meeting terminated.

Friday evening, 24th June, 1881.

TEACHERS' MEETING.

The Rev. Newton Price, M.A. (presidin managers of the Congress had felt th important the sentiments might be of ladies men more or less connected with the ma schools, and in some cases with the formati opinion, it was desirable to ascertain the op teachers, and to secure their hearty co-op more especially as there was a feeling that so were not altogether so favourable to the w

c economy as might be expected. He lieved the feeling to be much exaggerated, t here and there teachers looked upon the aching domestic economy as derogatory to r. The committee, however, were parious to elicit the opinions of the teachers . They desired not to be held responsible ngs which had been said by speakers, and have been a little painful to teachers. of our country depended to an enormous e way in which teachers did their work, od influence they exercised over the growing up under their care. They were increasingly the most influential body in The privileged classes, as they were called, but a mere handful, and having the edue bulk of the people in their hands, the ded really an enormous influence. The quite sure, therefore, that in pressing s upon their attention they would recognise sought to engage them in a work which eir fullest sympathy.

a Price, one of her Majesty's Inspectors of a short paper on his "Experiences in the of Needlework."

Cole said the ladies of the committee had adoption of the very plan mentioned by Pryce, but though their suggestion had eived by the educational authorities with t deserved, they were not daunted, and ned to secure a still more representative needlework next year. Possibly the comcity of the attendance at this teachers' attributable to the fact that domestic ned no part of the subjects taught by male , therefore, were not perhaps much in- It had been hoped that a relaxation of iles of the Education Department would many of the inspectors to be present, but he ody was not particularly favourable to the were pursuing.

a Price begged leave to state that, although nt in his private capacity as an individual, desired by the Department to give the Conassistance in his power. Most of the ine far away engaged in their duties throughtry, and those who were in London, were extremely hard work at the present time, eason their absence must be attributed.

Cole had been at considerable pains to e special benefit of the teachers invited to two specimens of certificates formerly eachers, and endorsed annually by the ith their opinions on the conduct by the e schools in their charge. Upon those cergrants were made. At present it seemed ements of the inspectors were very general, that the condition of the school was good ry, or had improved, and so on, but saying o whether the buildings were in proper e discipline efficient, or as to the teaching s subjects. He would like to know whether rs did really make a return upon all the governed the payment of public money the Code. When the education scheme arted in 1840 by Dr. Kay-Shuttleworth, were granted in the most thorough and er, and signed as was the one he had before l in 1848, by the superior authority over all e Lord President himself. Of that thorough a document should be which affected a ter and prospects, and, further, it enabled sted in educational matters to know more an did the modern certificate. It certified of knowledge possessed in each of the subsed in it *in the most exhaustive* manner.

A Lady inquired to what kind of school the certificate referred?

Sir Henry Cole said it had reference to a national school in the neighbourhood of London. At present the certificates were issued in the most general form, simply of three grades. For the fact that whereas, 40 years ago, teachers had real, genuine certificates given them, by some process altogether unknown those certificates had been turned into the present windy, useless documents; he was puzzled to account, but it was a mystery which he hoped they would get at the bottom of before long. He would ask teachers themselves, in the first place, which form of certificate they preferred; and he certainly thought that if the public were not to be allowed to know what they received for the money expended in training teachers, the sooner the better the system of giving certificates was abolished altogether as a mere fiction.

The Rev. Newton Price was of opinion that the teachers would probably prefer to have their acquirements stated; and there could be no doubt that managers of schools and the general public would also like to have the facts stated for their information.

Miss Guthrie Wright thought the form of certificate giving full particulars was based on the better principle.

Mr. Hugh Clements said that, as a rule, teachers objected to unnecessary interference with their private affairs, and considered that a too elaborate certificate would disclose more than they desired, or it was necessary should be known. Their training at the college was a sufficient guarantee that they had received a good education. On the other hand, they desired to have certificates on particular subjects, such as drawing.

Sir Henry Cole remarked that that certificate was given, not by the Education Department, but by the Science and Art Department.

Mr. Clements continued that teachers complained very much that the grants they now earned were so cut down that it was not worth their while to teach drawing at all. £400,000 a year was paid by the public, and out of that the Science and Art Department expended in grants only some £40,000, the rest being swallowed up in the expenses of administration. Teachers often spent their whole day in making up forms, when their time and attention would be much better devoted to their scholars and assistants. Continual alteration was made in the forms sent out to the teachers, and there was really no system followed by the irresponsible members of the School Board.

Rev. Newton Price observed that Mr. Clements was under an entirely wrong impression with regard to the immunities and privileges of the School Board. A very useful question had, however, been started by him, that of making the teachers' payment depend very largely upon results. Personally, he (Mr. Price) had been much opposed to the system for many years, and in the schools with which he was connected it had been entirely got rid of. It had been found that the payment of a lump sum was much more satisfactory to the teacher, whose mind should be left entirely free from monetary anxieties. He certainly considered that teachers' salaries should not be left dependent on the grants.

Mr. Barber, of Cheltenham, one of H.M. Inspectors, protested, in reference to the comparisons made between inspectors, against the notion too commonly held, that when the per-centage at examinations was found to have fallen, that the inspector on that occasion was the wrongdoer. There was no reason whatever why the assumption should be made.

Mr. Stephen Mitchell recognised the difficulty they had to deal with, as to what ought to be done, and he failed to see how it ought to be done, though he had visited schools of cookery, and examined the methods

of teaching. He thought it was especially ladies' work to suggest how the children of the operative classes could be so instructed that they might, as they grew up, be useful to their parents in home matters, and afterwards be better able to provide for husbands and children, by that means bringing up a healthier race of people. As it appeared that no definite resolution was to be passed in the matter, he was afraid that this, like all other Congresses, having led to much talk, would have no practical result whatever.

Mr. Clements thought Congresses were instrumental in changing public opinion. When the people became convinced of the utility of new methods, and desired that they should be put into practice, they soon brought the pressure to bear on the Government for the adoption of the necessary measures. On so important a subject as this they could not have too many Congresses and meetings of all kinds, affecting as it did, the food of the people.

Sir Henry Cole thought the use of Congresses had been unjustly depreciated by Mr. Mitchell, and quoted the opinion of Professor Huxley as to their value, as Government always lagged a little behind public opinion, and Congresses were a most efficient means of pressing them on. He then proceeded to read a list of the teachers who had gained prizes offered by the Society of Arts.

LIST OF AWARDS OF MEDALS FOR PAPERS IN THE TEACHING OF DOMESTIC ECONOMY.

1. "The Teaching of Domestic Economy," by Miss E. M. Brant, Board School, Berkhampstead, Herts.
2. "The Itinerant Method of Teaching Domestic Economy in Public Elementary Schools," by William J. Harrison.
3. "How I Teach Sewing," by Miss Jane B. Curry, Episcopal School, Dumbarton.
4. "Instruction in Needlework," by Miss Eliza Jane Allen, St. Mark's Girls' School, Belgrave-gate, Leicester.
5. "Needlework considered under Four Heads," by Miss Sarah A. Hall, National Schools, Beachampton, Bucks.
6. "Some Points considered in Teaching the Second Branch of Domestic Economy," by Miss Harriet Martin, of Whitelands, Chelsea.
7. "How I teach Practical Cookery," by Miss Buncle, Episcopal School, Dumbarton.
8. "Practical Cookery in Elementary Schools," by Miss A. M. Griggs, School of Cookery, 6, Shandwick-place, Edinburgh.

The meeting then adjourned.

Saturday, 25th June, the Countess of DERBY in the chair.

Sir Henry Cole read the report of the Executive Committee to the Council of the Society of Arts. [Printed in Council's Report, *ante* p. 653.]

The adoption of the report was moved by **Lady Derby**, and seconded by **Lady Stanley of Alderley**.

Sir Henry Cole said that by agreeing to the substance of the report, the ladies present would add to its force when sent before the Council, with the weight of their adhesion.

The resolution was carried unanimously.

Sir Henry Cole then said the only remaining work for the Congress to do, was to express their approval of the announcement that they should go to the Lords of the Council with such representations on this subject, as would be likely to influence them in making an alteration in the Code. The request, which had been already signed by the Duchess of Leeds, Lady Stanley of Alderley, and other ladies at the Needlework Conference, was as follows:—"The Executive Com requested to make arrangements for holding bition of Plain Needlework, in 1882." Th was to be communicated to my Lords, and, i they would be asked to receive a deputatio who would express their views.

Mrs. Dacre Craven said she had been in it was only proposed to hold the exhibition years. Exhibitions of industrial work ca held only at intervals of ten years, but in c that character it was necessary to exhibit nev and to show that the work was attended to It had been considered, therefore, that to h bitions every two or three years would g interest to needlework in the schools, and tl pledged to five years.

Sir Henry Cole said the request had been sufficiently authentic exhibition to take pla That could only be done effectually throug ment, the whole machinery, and everythi at the South Kensington Museum. There insuperable objections probably to periodic being held if they were desired.

A Lady suggested that it might be usefu were asked to send up reports of what th doing.

Sir Henry Cole said that was just what had engaged to do. They proposed to m extensive inquiries, and that would be the of the Executive Committee. As the last Education Department had only given schools where cookery was taught, the Con ing it very imperfect, had drawn up a set o the point, which they had been permitted cation Department to send to the inspecto and the result showed that in mo instances cookery was taught. A mo amount of information besides, which ha before Parliament, would be published in the document they had prepared. He proposing a vote of thanks to Lady Derb passed unanimously, as was a similar vote t for her services to the Congress.

Sir Henry Cole, before declaring the Con year at an end, was desired by the Lady say that it had not been from want of i objects that she had not previously atte confirmation of that statement he would she had, in another practical way, shown assist in the carrying on of these Congres

The Congress was then declared at an e

MISCELLANEOUS.

SECONDARY BATTERIES

The following description of the Pla Faure secondary batteries is taken from th the editor of which paper has kindly le (from *La Lumière Electrique*) to illustrate it. 2 (p. 687) represent the Planté cell.

The preparation is as follows:—Two shee laid the one on the other, separated by tw india-rubber, the whole being rolled up as sh 1. The roll having been completed, the cyli its formation is withdrawn, and it is cov a wrapper of gutta-percha, and inserted jar filled with water, and 1-10th part electric current is then made to pa the cell, oxygen is given off and produ cushion of peroxide of lead in one sheet; l

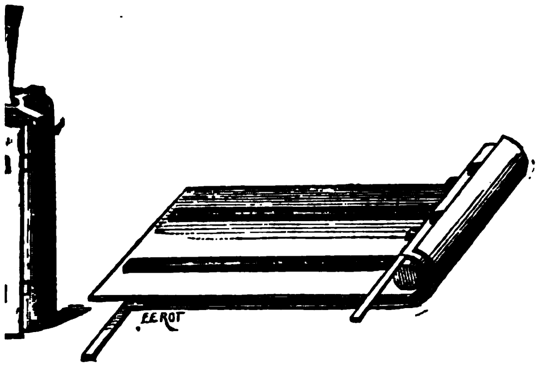

FIG. 1.

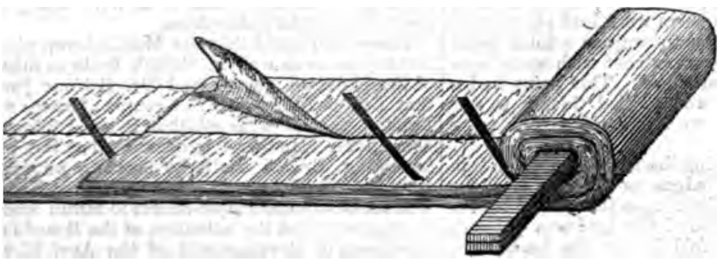

FIG. 3.

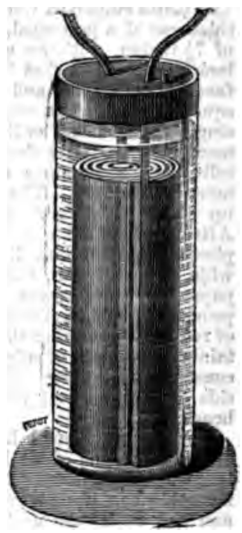

FIG. 2.

! at the other sheet. If the current with which has been charged be cut off, and the two sheets iected, a current will be produced owing to the

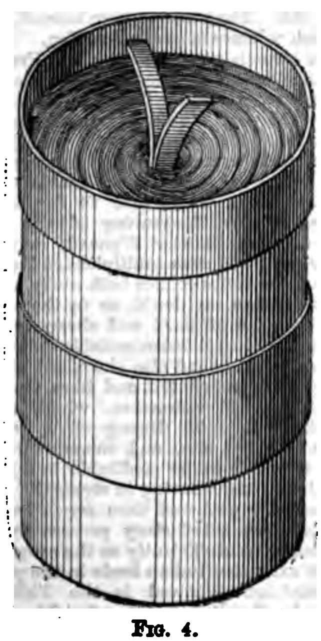

FIG. 4.

of the oxygen, which leaves the sheet where it imulated and attacks and oxidises the other This secondary current, which is very small at first, gains strength each time the operation is repeated; in course of time the surfaces of the sheets are changed, the one being covered with a cushion of peroxide of lead, the other with lead reduced to a spongy mass. The cell is now complete, and in a state of electrical accumulation.

Subsequently, M. Planté tried the plan of separating the two sheets of lead by canvas, the cell taking the form of Fig. 2. He next found that it was necessary to leave a small space between the sheets to provide for the escape of the gases which were produced at the end of the charge; subsequently, india-rubber bands were employed in preference to canvas. M. Planté also tried carbonate of lead, minium, &c., but without improving upon the results already obtained.

The Faure battery is very similar to the above, and is constructed thus:—Two sheets of lead are taken, 0·20m. large, the one about 0·60m. long and 0·001 thick, the other 0·40m. long and 0·0005m. thick. Each of these is furnished with a strong strip of lead at one of its ends. Each sheet has a layer of red lead spread on its surface, the lead being made into a paste with water, the larger sheet having about 800 grammes on its surface, and the smaller 700 grammes. On each surface a sheet of parchment is laid, and the whole is introduced into a sheathing of thick felt. The sheets are laid one above the other; at the same time several bands of india-rubber are placed in an oblique fashion, as shown in Fig 3. The roll is placed in a leaden jar, strengthened by copper bands, and supplied in the interior with red lead and felt. The cell then presents the appearance shown in Fig 4. One of the pieces of lead which jut out is curved and soldered to the outer jar, acidulated water is put in, and the battery is ready for work.

Some experiments with an extemporised Faure battery have been carried out recently in the office of the *Scientific American*, which are described as follows:—"In attempting to follow M. Faure's plan of construction, some

difficulty was experienced in making the red lead remain in place during the rolling up of the two electrodes. Therefore, the battery was constructed of square plates of lead, each having an ear projecting upward from one side, for attachment to a binding post. This plan succeeded very well, the flat plates having the advantage of retaining a great quantity of red lead and of being easily formed into a compact pile. The plates employed were of pure lead foil, having the thickness of a post-card, a width of 7 inches, a height of 7½ inches, with an ear projecting from the top 1½ inch wide and 3 inches high. The total effective surface on both sides and edges of each plate was 100 square inches. Ten such plates were sufficient for a single element for ordinary uses, and such an element may be fairly charged by means of four gravity cells, but a stronger current is much quicker and more satisfactory. The method followed in building up these secondary elements was as follows:—After cutting out a sufficient number of lead plates, pieces of canton flannel, 15 inches long and 7½ inches wide, were cut; and, finally, as many sheets of blotting paper, 7½ inches square, as there were lead pipes, were provided. The next step was to prepare a thick paint of red lead by mixing the dry pigment with water containing one-tenth of sulphuric acid. This paint had a consistency of paste, and was applied thickly to one side of the sheet of lead with a common flat paint brush.

The canton flannel having been painted to within one-quarter inch of all its edges on the nap side, the lead was laid, painted side down upon the painted canton flannel, when the other side of the lead was painted, and the cloth was neatly folded over the lead, completely enveloping it with the exception of the ear at the top, and projecting about one quarter inch beyond all the edges of the lead. The lead with its envelope was then laid upon a level board, and another plate was prepared in the same manner and placed over the first, with an intervening layer of blotting paper, and with the ear placed opposite the ear of the first. Other lead plates were added in the same way, with the interposed sheet of blotting paper, and with the ears alternating in position. When ten plates had been placed together in this manner they were clamped together with two or three elastic bands, and the ears were brought together and passed through a slit in the wooden cover of the containing cell and bent down upon the top of the cover. They were then pierced and traversed by the screw of a binding post which entered the wood. In this way each pole of the element was furnished with a binding post, and at the same time firmly secured to the cover. The cell was then partly or wholly filled with acidulated water—water 10 parts, sulphuric acid 1 part—and after the cloth and blotting paper had become saturated the element was connected with four gravity cells. In one hour the element had stored electricity sufficient to heat 1½ inch of fine platinum wire to redness, to work a magnet strongly, and to run at a high rate of speed for fifteen minutes a small electric motor that requires at least ten gravity cells to operate it. After this preliminary experiment a number of the new secondary elements were prepared in the same way and charged separately with a dynamo-electro machine. One element of ten plates, after receiving the current from the dynamo for ten minutes, operated the small motor above referred to, for something over three hours. Another ten minutes' application of the current from the dynamo charged it so that after eighteen hours of rest it yielded a current which seemed as strong as when it was first charged on the previous day; but a time test proved that it was incapable of running the motor for quite so long a time as when the current is used soon after storing."

The Faure battery was exhibited for the first time in England at the *Conversazione* at King's College, on Saturday, 2nd inst., when it was used to light the Swan and Lane-Fox electric lamps.

PLANTAIN TREE.

Mr. L. Liotard has prepared an elaborate m dum on the plantain tree (dated Calcutta, Jan 1881), of which the following is an abstract:—

Dr. Balfour, in a note dated the 15th Octob has noticed the Agricultural Department dep memorandum on fibrous materials in India su the manufacture of paper; and he speciall attention to the chapter on the plaintain tree species of this tree, or rather, plant, have be in India from the most remote times; but ducer of marketable fibre, the only species w yet come to note is the *Musa textilis* of the I Islands: this yields the fibre known in com Manila hemp.

The introduction of the *Musa textilis*, in 18 from the Philippine Islands into the Madras P is described in the printed memorandum, w shown that attempts made to extract the fib country for commercial purposes proved although thousands of tons of it were being every year in the Philippines.

There is no doubt that the Manila hemp pl *textilis*) grows as well in British India as oth of the plaintain genus; and Dr. Balfour ju that British India could in a couple of years London market with all that it could take hemp fibre. He therefore observes that the p benefiting British India by creating an ex from it of the extent and value above indic well incite to considerable efforts to attain su he suggests that the attention of the Boards missioners of Revenue, and of the Agri-Ho Societies might be re-directed to this plant.

It is known that the *Musa textilis* was r success in Calcutta as an experiment in 1822, 1840; that fibre was extracted from the p made into a neat cord no way inferior to Eng cord; and that a project was then put forwa establishment of the manufacture of pape fibre; but we do not know how or why the p not carried out. The projector, we learned, of the British colonies in South America.

We know also that in the Madras Pres efforts to introduce the *Musa textilis* were extended nature, beginning from 1858; tha planting proved very successful; that num plant were introduced and reared; that th tracted therefrom were cleaned and experime and were found to possess considerable st gloss; to be very clean, and fit for ta also that success in the rearing of the especially attained in the Wynaad, whe remarkably well and was multiplied in larg in several of the coffee estates both easily an and that there was no doubt as to the va fibre, but that the efficient and cheap pre the fibre remained an unsurmountable difficu

In the Andaman Island also the plant wa fully reared and propogated, and fibre was but the process of extraction, which co steeping the stem until decomposition set probably a very bad one, and consequently which was reported to be creditable in othe was found harsh and wanting in strength.

The experience gathered thus seems to p discovery of some satisfactory process for the fibre cheaply and efficiently as the essenti nary to any extensive Indian trade in the pro mode of treatment followed in the Philip first be noted; the British Consul at Manila it as follows:—

"When the trees have matured, or are cutting, they are cut down about a foot ground; and the labourer then proceeds to the layers from the trunk, which are cut into

inches wide, or say, three strips to each
These strips are then each drawn through
a blunt knife and a board to remove the
egetable matter from the fibre, which is then
n the sun to dry. As soon as it has been
ily dried, it is ready for the market. The
ice of the fibre depends entirely on the care
l in drying it, as, should it be exposed to rain,
thoroughly dried, it becomes discoloured, or
a brownish tinge, and loses the strength to
ent.

* * * *

egards machinery, several attempts have been
at have proved unsuccessful, to invent a suit-
hinery for cleaning, to supersede the primi-
nod still in use, which consists of a few cross
ght bars of bamboos, to which are fastened the
id cleaning knife, the fibre, or rather, the
strips, being introduced between the board and
e, which latter is then held down by a string
to a cross bamboo, on which the foot of the
i is placed, and the strip is pulled through,
oving all the vegetable matter."

nnual quantity of Manila hemp which is ex-
y this means in the Philippines is reported to
40,000 tons, of which the United Kingdom
out half.

er any improved method of extracting the
r be not discoverable, there does not appear to
eason why the method of extraction followed
Philippine Islands should not be adopted in
India, with any modifications which experience
ggest.

myself tried an experimental process, in de-
hich I was guided by the considerations below
d.

rst of these was the structure of the plant. It
sed of layers of fibre united together longi-
y by cellular tissues which contain a very large
age of mucilaginous and pulpy matter in which
colouring matter is present. There are in the
the trunk three distinct qualities of fibre—it
and strong in the outer layers, fine and silky
nterior, and of a midling quality in the inter-
layers, while the central foot-stalk contains no
all. The mid-rib of the leaves also contain
bre.

lly, the proper time for extracting the fibre.
of importance if the fibre is ultimately to be
cordage or textile manufactures, but of less
nce, perhaps, if the fibre be destined for
aking. The proper time is when the purple
lk is about to rise, but has not quite appeared
is then that the fibres are in their best condi-
fore that, the fibres will be immature, after
y will have lost their strength.

ly, the appearance of the fibre. All fibre is
according to the degree of its cleanness, its
, and its uniform structure; and if, in addition
three qualities, the fibre is of fine texture, it
mand a high price. It is thus necessary to
the fibres. The easiest way to do this is, after
t is cut down, to strip layer after layer from
k, each strip being about two inches wide, and
the layers according to the fibres they contain,
will be found to present the features above
The stripping is very easily effected by the
th the help of a knife, and has the advantages
securing uniformity in the fibres by classifica-
l of facilitating their extraction, as will pre-
e explained. The mid-rib of the leaves should
nto four parts to facilitate the crushing, and
e kept apart from the produce of the trunk.

hly, the time taken in the operations. The
should be utilised on the day on which they are
nd they should be manipulated in the shade.
ons are that if the fibre be not forthwith extracted, the fleshy or sappy compounds, if subject to wet, will decompose; whilst if they are exposed to the action of the sun's rays. the fibre will be discoloured. Further, the immediate removal of all extraneous matter reduces the bulk of the product, and thus decreases the cost of transport to storage centres.

Looking to the benefit that will result to the country, should success be attained, and the very small expense that will in any case be required, the Government of India may perhaps be disposed to give this process some effective trial in some convenient localities. If so, it might be well to make a beginning in the Wynaad, where the true *Musa textilis* has been successfully introduced and propagated, and where, I believe, large numbers of the plants exist.

A further suggestion which I would venture to make is, that experiments should be made with some of the native varieties of the plantain tree, those varieties being preferred which grow on hilly land, as these contain more fibre than the varieties on low-lying flat ground which are valuable in other respects. Thus, in the Governments of the North-Western Provinces and the Punjab, trial might be made with the species of the plantain trees that grow on the lower ranges of the Himalayas, that is, below Mussoorie, in the lower tracts of the Nahun State, in the Umballa district, and in Kangra. It is just the species that produces insipid fruit, sometimes with seed inside, that will be found to yield a larger per-centage of fibre.

In Bengal, Bombay, British Burma, and the Central Provinces the indigenous species growing on the high lands might usefully be experimented with, the above remarks giving an idea of the kind of plants to be selected.

The real obstacle, however, to the successful introduction of new fibre materials into our export trade is the cost of railway fare. On this point I will reproduce here the remarks which I made in the memorandum I referred to at the beginning of this note:—

"The cost of the carriage, not only of fibres, but of all raw and natural products of India, from the internal districts to large centres of population and to export marts, prevents such products from being utilised, and a large source of income to the country is thus neglected. We find that Mr. Rendell, in his evidence before a Parliamentary Committee, stated that the cost of carrying a ton of goods for a mile is, on the East Indian Railway line, ·218d., and the average cost on nine lines ·376d., or $\frac{3}{8}$ths of a penny. Before long, he says, the cost on the East Indian Railway of carrying a passenger, or a ton of goods, for a mile will not exceed $\frac{1}{10}$th of a penny or $\frac{1}{8}$th of a penny respectively; and though that rate may not be attainable on lines less favourably situated as to fuel, gradients, and quantity of traffic, the cost of transport ought not in any case to exceed $\frac{1}{2}$d. per ton per mile, and $\frac{1}{8}$d. per passenger per mile. 'Experience,' Mr. Rendell said, 'shows that a reduction of rates, especially for passengers and cereals, is always accompanied by a large increase of traffic.' He added that, as consulting engineer of the East Indian Railway and States Railways, he would strongly advocate a reduction of rates, and he was certain that such a policy would ultimately prove remunerative. There can be little doubt that, as regards fibres also, the same beneficial results will be produced by a reduction in the rates."

The Bombay Chamber of Commerce, in a letter addressed on the 9th May, 1879, to the Famine Commission, said:—

"The high rates charged for the conveyance of goods have prevented Western India from reaping all the benefits which were reasonably expected to flow from the introduction of the Great Indian Peninsula system into this Presidency. This statement is borne out by the fact, that on a recent occasion, when a reduction of their grain rates was made, a very large development of traffic immediately occurred and has steadily progressed. In September, 1875, the Great Indian Peninsula Rail-

way reduced their grain rates from the producing districts in the Central Provinces of 5½ pies per ton per mile, being a reduction of 30 per cent. on their previous rates. This reduction left the rates still considerably higher than the East Indian Railway Company's rates, but it led at once to a very great increase in the traffic."

The Bombay Chamber of Commerce then went on to quote figures of exports in illustration of the rapid increase in the traffic, and added:—

"But these illustrations of the effect of reduced rates prove that even railways in India may be of little avail in fully developing the resources of the country if the rates for the carriage of produce are not reduced to the low scale necessary to attract the produce of the districts through which they pass."

There can, therefore, be no doubt that a reduction in the rates of railway carriage for the fibrous, as well as other, products of India would have a beneficial result.

I venture now to suggest that the question be referred to the Public Works Department for early consideration. If a reduction of rates for all fibrous materials is not feasible at present, I would earnestly suggest that such materials, when destined for paper manufacture at least, be allowed to be carried over the railways at rates lower than those now imposed. A gentleman who is engaged in the business in Lower Bengal writes to me on this subject as follows:—

"A great deal of raw material, which could be utilised for paper-making, cannot be brought down by rail on account of the high freight payable according to the present goods tariff of all railways in India.

"Amongst the well-known materials used for paper-making, take, for example, aloe-fibre, jute, hemp, flax, rags, and waste papers; all these, when loosely packed, are at present put in Class 2, the rate of which is 50 pies per 100 maunds per mile. Mounj or any other grass or plaintain leaves, when loosely packed, belong to class 3, and are charged 66⅔ pie per 100 maunds per mile. Plantain leaves and grass have an additional obstacle in being subjected to a minimum weight of 81 maunds.

"Now, you are well aware that aloe-fibre, jute, hemp, flax, when destined for twine or textile manufactures, might be able to bear a second-class rate on account of their higher market value; but, seeing that it is only the cuttings or waste of these materials that are used for paper manufacture, they cannot possibly be of so high a value, and cannot, therefore, bear the same charge. The cuttings or waste should consequently be treated specially and charged a much lower rate."

This can, I venture to think, be done by placing all materials destined for paper manufacture under a distinct head of "paper-making materials" in the goods tariff, and classing the head under Class I. (*i.e.*, 33⅓ pie per 100 maunds per mile) when the material is loosely packed, and under special class when despatched, pressed or screwed in bales. In neither case need there be any restriction as to minimum weight, and the usual reduction might be allowed when carried over 150 and 300 miles respectively.

CHINESE MATTING.

The following remarks from a paper by Dr. Hance, of Hong Kong, published in vol. viii. of the *Journal of Botany, British and Foreign*, are supplementary to the article in the *Journal of the Society of Arts* of May 27th, p. 595. The plant used for sails of native craft, or for covering boxes, and described in the United States Consul's report as an "aquatic grass" or "rush," is a cyperaceous plant, known to botanists as *Lepironia mucronata*, Rich. It is recorded as a native of the Indian Archipelago, Australia, and Madagascar. Of the matting made from this plant, Dr. Hance says the natural colour is a pale brown, nor is he aware that it is ever dyed, nor, so far as he knows, is it ever "exported to foreign except, doubtless, in the form of bed mats fc residing in Australia and California. It is ce markable that a plant of comparatively lir graphical distribution, and in none other apj its native localities turned to any account, sho the raw material for a vast manufacturin and, perhaps, still more strange, that the so should not before have been discovered. As of *Hydropyrum latifolium*, Griseb., whic thousands of tons of a favourite vegetable, it much we may have still to learn, even at th most frequented marts of trade, concerning which many apparently insignificant plan The attention of the authorities in our posse Straits of Malacca, and of those of Netherl might be advantageously directed to enc cultivation of this plant, and so developing profitable manufacture."

Regarding the floor matting, which fo important trade with America that it ranks value about sixth or seventh of all articles foreign countries from Canton, the wl matting is woven from the culms of *Cyperu* Roxb. It does not seem to be known wha fà" plant is, from the flowers and seeds yellow dye is prepared, but Dr. Hance i that the "lam-yip," or blue plant, is refe natural order "Acanthaceæ."

From a table showing the export of matt port of Canton from 1870 to 1877 inclusi that, next to North America, Hong Kon largest quantity, Great Britain taking th the years as stated above the largest q exported in 1872, when 115,220 rolls were

CORRESPONDENCE.

DOMESTIC ECONOMY CONGR

By an error in the report of a previous mee I was made to point to the educational adm St. Pancras as a model for imitation. On th pointed out the educational administration half-time school of Anerley as the model f of St. Pancras, so far, as appeared, and of ot

EDWIN

GENERAL NOTES.

Portable Disinfector.—The principle adc disinfector, by Mr. Washington Lyon, is the of steam, under regulated pressure, into a s structed apparatus, in place of dry heat, for t destroying all forms of insect life and the low germs, &c. The chief advantages claimed for t are that, while all kinds of wearing apparel, be ture, &c., can be disinfected by its means, no a unmade, the colours of silk, woollen, and cott are unaffected, papers are uninjured, and all smell is avoided. The apparatus is made of iro outer casing, with a space between, into which pressure of about 25 lbs. is admitted. The a disinfected are placed in the interior, and the do Steam, at a pressure of about 20 lbs., is then a the interior, which raises the temperatur 259° Fahr., and the process of disinfection The presence of the steam in the casing prevent tion of the steam in the chamber. A working n disinfector was exhibited last year at the Soci during the meeting of the Conference on the Public Health, and it has since been brought i use.

L OF THE SOCIETY OF ARTS.

No. 1,496. Vol. XXIX.

FRIDAY, JULY 22, 1881.

tions for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

RT FURNITURE EXHIBITION.

hibition of Works of Art Applied to in connection with the Exhibition of at the Royal Albert Hall, is now open non-transferable season ticket will be y member of the Society on application retary. A ticket, to admit two persons, h the present *Journal*.

EDINGS OF THE SOCIETY.

PLANT LABEL COMMITTEE.

TEE.—George F. Wilson, F.R.S. (Chair- J. Bramwell, F.R.S. (Chairman of the Lord Alfred S. Churchill, Rev. H. Harpur ofessor W. T. Thiselton Dyer, F.R.S., Rev. combe, H. J. Elwes, Sir Joseph D. Hooker, C.B., F.R.S., Whitehead Jeffrey, George Rev. J. G. Nelson, William Sowerby, Rev. Wolley Dod, and Colonel Trevor Clarke.

owing is the Report of the Committee, been adopted by the Council:—

ditions under which the Society's Silver d the £5 prize, provided by Mr. G. F ere offered, were as follows:—

Council of the Society of Arts are prepared a Society's Silver Medal, together with a £5, which has been placed at their for the purpose by Mr. G. F. Wilson, or the best label for plants. The the offer is to obtain a label which heap and durable, and may show legibly is written or printed thereon; the t be suitable for plants in open border. nsiderations will principally govern the The award will be made on the recom- n of the committee, which will be ap- or the purpose by the Council. Specimen aring a number or motto, and accom- a sealed envelope containing the name of r, must be sent in to the Secretary of the ot later than the 1st May, 1881. The Council reserve to themselves the right of with-holding the medal and prize offered, if, in the opinion of the judges, none of the specimens sent in are deserving."

In answer to this notice, which was first issued in January last, 120 sets of specimen labels were sent in. Some of these are ingenious, but many show ignorance of the conditions to which labels are exposed in open borders, rock-work, &c. There are a great number of applications of glass to labels; some of these specimens were broken even in the transit, showing how unsuitable they are to stand rough usage. Some very useful labels have been sent in, which, though perhaps not absolutely new, are unknown to the generality of cultivators.

The committee are of opinion that none of the labels sent in competition are deserving of the Society's medal, but they have pleasure in expressing their opinion that the following possess many points of merit, and they therefore beg leave to draw the attention of persons interested in the subject to them:—

E. J. Alment, 194, Romford-road, Stratford.—Zinc labels, with galvanised iron wire stems.

J. Pinches, 27, Oxenden-street, S.W. — Zinc labels, with stems of zinc, iron, and oxidised iron.

Thomas Johnston, Saw Mills, Renfrew, Scotland.—Labels of teak wood.

J. Wolstenholme and Son, Grimes-street, Mill-street, Ancoats, Manchester. — Holly-wood and box-wood labels.

Rev. H. Ewbank, St. John's, Ryde, Isle of Wight.—Wood labels, with iron wire supports. These are painted white, and a coat of black paint added, which, when wet, is removed where the letters are required, in order to show the white ground beneath.

J. Wood, Woodville, the Spring, Kirkstall, Yorks.—Zinc labels, with galvanised iron wire supports.

Walter J. Todd, 32, Angell-road, Brixton, S.W. —Wood labels, with wire supports.

C. Yates, Mortlake. — Zinc labels of various patterns; ink for writing on same.

S. Mount, Harbledown, Canterbury.—Painted iron labels.

J. C. Turner, Salisbury-road, Blandford.—Zinc labels.

J. Dowdney, 1, Montpellier-villas, West-street, Croydon.—Wood labels, with wire supports.

Rev. C. Wolley Dod.—Iron and wood labels.

There is also an iron label sent in by the Rev. H. N. Ellacombe, for the inspection of the committee, though not in competition, which is well deserving of notice, since it has been in use for more than sixty years in Mr. Ellacombe's garden, and is still in perfectly sound and good condition.

The committee would suggest that the proprietors of the labels sent in should present their specimens to the Council of the Royal Horticultural Society, if that society is willing to accept them, in order that they may form a permanent exhibition of labels. They also recommend that the offer of the prizes should be renewed for the following year, and for the guidance of future competitors they offer a few suggestions.

Wood is probably the cheapest and best material for cheap labels. It is at present liable to the

objections that the part in the ground rots, and the writing on the label becomes illegible. If by some process, such as perfect kyanizing or treatment with paraffin, these objections could be removed, an excellent cheap label would be the result. Such labels, however, would have to be tested in actual use against unprepared labels, before any award upon them could be made, Slate labels, made thick enough not to break. might be useful. Cheap thick glass labels might be useful for the same purpose, if proper means of writing upon them were provided.

H. TRUEMAN WOOD,
Secretary.

CANTOR LECTURES.

WATCHMAKING,

By Edward Rigg, M.A.

LECTURE II.—DELIVERED MONDAY, FEB. 14, 1881.

Degree of accuracy required in the ordinary watch—Fourteen years' statistics of the clock and watch trade—Systems of manufacture in this country and abroad—Description of specimens illustrative of the various stages of construction—Comparison of the several systems.—Suggestions.

The latter portion of the last lecture was devoted to the consideration of certain points connected with the manufacture and adjustment of high-class watches. I endeavoured to show that, although it may be quite possible to produce a going-barrel watch that shall indicate strictly accurate time at any period through the 24 hours, the care required in the adjustment of so perfect a timekeeper is far greater than when a fusee is employed, for the variation in the force of the best going-barrel springs will cause the arc of vibration to fall off to the extent of about 100°, an amount which represents a very severe tax on the isochronism of the balance-spring. As the delicacy of the instrument may be considered to be in proportion to the care required in its adjustment, it is difficult to see what valid reason can be urged against the fusee in such watches as we are considering. By securing a motive force that is approximately uniform, it very materially diminishes the labour involved in the production of a timekeeper that can be relied on to be accurate throughout the whole day, and, therefore, may be said to actually reduce the cost of manufacture of the best English watch, at the same time increasing its reliability.

But, after all, it is not every buyer that requires such an exact instrument; and the table given at the end of the last lecture seems to show that, for ordinary use, the going-barrel watch has been the subject of very marked advance in recent years. Formerly, when the English and Swiss makers had the entire trade of the world practically in their own hands, and while the English fusee watch was celebrated as a high-class timekeeper, the Swiss going-barrel had complete control of the cheaper markets. But since about the middle of the present century the production of France has very largely increased, and more recently American manufacturers have appeared as competitors, both in their own country and in Europe. This rapid increase in total production, and the improvements in the going-barrel, point to the conclusion that English makers should examine most minutely into their system of working, carefully study the merits of every suggested improvement, and themselves take the watch in hand, investigating any weak points in its design or system of manufacture.

That there is urgent need for such exertions in the present day, especially in regard to the medium and cheaper class of watch, is, I believe, generally admitted, and I have been at some pains to collect such statistical information as might enable us to see how far the growth of foreign competition during recent years is real: the returns suffice to show that the English watch trade is, in a sense, in a more hopeful condition than some would have us believe, notwithstanding that it cannot be said to exhibit any marked signs of growth.

They cover a period of fourteen years, namely from 1867 to 1880, and are comprised in six tables. Some of the information has been already published, but only a very small proportion of that has given, and never in a collected form. Thus certain hall-marking returns are annually made public, but many of the figures in Table VI. are new, having been expressly supplied to me by the authorities of the Assay Offices at Birmingham, Chester, and London, to whom I would here express my thanks. The fulness of the returns of imports and expo as compared with those hitherto accessible, may be gathered from the fact that these latter have consisted only of (1) total annual imports of clocks in number and value, and (2) total annual imports of watches in sterling value. These constitute columns 14, 15, and 20 of Table I. Exp have been entirely ignored, as also the detail regard to imports. I should mention that oversight has evidently arisen from the fact that only the Monthly Statements and Annual Abstr of the trade of the United Kingdom, published the Board of Trade, have been consulted; whe it is only the "Annual Statement" of the Department that contains the full information

It would be impossible, within moderate spac discuss these returns fully; an attentive exam tion of the figures will be well repaid, as it will b to light many points of interest, the import of which one individual may be in a be position to appreciate than another. I prop however, to add a few notes to each table, draw attention to its most prominent features.

Table I.—The superior quality of the clocks ported from France is made very evident dividing the value (which, I may here ment means "declared value") by the number each country. Thus, taking the year 1879—

A clock from	Belgium*	is valued at	£0·43
,,	France	,,	3·27
,,	Germany	,,	1·28
,,	Holland	,,	0·27
,,	United States	,,	0·36

Our imports of these cheaper clocks are incr ing at a rapid pace, whereas those from Fra remain stationary. This fact is brought i prominence by the column headed "mean pri The numbers of clocks from the United States Holland are nearly identical.

* It should be noticed that where Belgium is mentioned i gard to imports, it may taken to mean Swiss manufactures ship at Belgian ports. Similarly, Holland exports the manufactu the Black Forest.

Year.	Clocks from															Watches from				Total Value of Imports.	Net Imports.			
	Belgium.		France.		Germany.		Holland.		United States.		Other Countries.		Total.		Mean Price.	Belgium.	France.	Other Countries.	Total.		Clocks.		Watches.	Total.
	Nos.	Value.	Nos.	Value.	Nos.	Value.	Nos.	Value.	Nos.	Value.	Nos.	Value.	Nos.	Value.							Nos.	Value.		
		£		£		£		£		£		£		£		£	£	£	£	£		£	£	£
1867	...	...	88,861	198,136	...	...	37,505	9,914	123,800	52,247	1,189	2,994	251,355	263,291	1·048	8,248	178,040	2,895	189,183	452,474	240,983	257,448	185,892	443,340
1868	...	...	94,313	215,310	....	...	29,243	8,963	114,744	48,611	2,946	4,474	241,246	277,358	1·150	8,664	183,677	6,515	198,856	476,214	235,419	269,396	195,341	464,737
1869	...	...	133,196	224,624	1,478	2,492	24,850	10,603	170,405	79,569	483	1,720	330,412	319,008	0·965	14,162	183,057	1,988	199,207	518,215	322,762	311,995	196,093	508,058
1870	...	...	92,348	181,517	1,227	3,069	17,156	8,884	143,973	62,780	2,157	2,378	256,861	258,628	1·067	221,723	128,318	22,379	372,420	631,048	244,737	249,174	343,163	592,337
1871	2,311	3,923	91,474	269,380	4,500	5,842	28,882	18,711	198,174	75,266	166	312	325,507	373,434	1·147	434,386	24,486	10,542	469,414	842,848	368,992	360,970	409,514	770,484
1872	2,096	2,788	123,898	327,711	3,884	4,292	46,069	27,230	198,214	75,619	80	391	374,241	438,031	1·170	270,496	77,312	3,391	351,199	789,230	348,773	417,227	342,467	759,694
1873	5,608	3,522	102,018	302,106	3,700	4,827	51,566	25,364	242,693	92,023	37	186	405,622	428,028	1·055	331,421	67,276	8,586	407,283	835,311	385,797	408,945	400,804	809,749
1874	5,077	4,281	92,574	271,459	3,870	6,430	52,788	16,768	266,374	101,524	173	250	420.856	400,712	0·952	425,073	43,566	5,480	474,119	874,831	395,735	380,218	470,177	850,395
1875	7,974	5,684	96,897	254,886	5,155	9,669	123,749	27,452	285,028	107,029	10	76	518,813	404,796	0·780	409,652	37,056	4,489	451,197	855,993	490,903	383,820	443,718	827,538
1876	39,750	13,610	101,081	281,022	6,245	9,235	188,168	44,337	265,818	98,651	17	100	601,029	446,955	0·744	414,951	27,618	7,498	450,067	897,022	556,571	417,411	430,670	848,081
1877	42,124	15,391	101,487	314,325	7,242	10,016	239,687	65,283	296,542	107,780	189	592	687,271	513,387	0·747	484,573	16,636	2,955	504,164	1,017,551	635,644	486,276	480,121	966,397
1878	17,961	6,863	1 00,136	357,605	6,080	9,177	313,448	86,925	294,453	101,049	1,944	973	734,022	561,592	0·765	496,042	11,393	5,033	512,468	1,074,060	677,228	531,962	481,868	1,013,830
1879	13,394	5,761	92,545	303,816	5,299	6,787	342,491	93,127	376,023	133,856	164	94	829,916	543,441	0·655	435,357	7,702	15,529	458,588	1,002,029	760,683	505,101	428,243	930,113
1880	23,473	8,067	92,747	285,950	10,862	11,609	336,929	95,314	405,897	153,815	121	263	870,029	555,018	0·638	415,028	6,205	6,430	427,663	982,681	719,811	481,522	401,646	883,168

In regard to imported watches, there are several noticeable facts. Since 1870, the beginning of the Franco-German war, Swiss watches have come to this country by way of Belgium instead of through France; indeed, the tariffs imposed by the French Government are so prohibitive, that the great majority of the French watches pass into Switzerland, and are then exported to England by the same route. Under "Other Countries," in 1880 are included watches to the value of £2,115 from Holland, and £2,197 from the Channel Islands.

The American watch trade does not figure in the returns, for imports from ' Other Countries" only amount to about £5,000 per annum. 1876 was the only year in which America was specified, when the amount recorded was £4,272 (and this I have included with the amount given for "Other Countries"). The relatively large figure in 1879 comprises £13,933 from Holland; and thus the returns, full as they are, must be regarded as deficient in this important particular. The omission appeared to me to be so serious that I consulted Messrs. Robbins and Appleton with a view to its explanation, and they have obligingly given me, for publication, the number and value of their imports into this country during last year. The "movements" imports numbered 24,330, and the approximate value was £40,000; the reason for the omission from the official returns appears to be that the watches are all without cases, and are therefore classed at the Custom-house as "watch materials." These figures will enable us to apply an approximate correction to the total imports for the previous years.

The section headed "Net Imports" is deduced from the total imports by deducting the exports of foreign produce shown in Table IV.; the figures thus obtained, together with the American watches imported, must be taken to represent the annual home consumption of foreign-made clocks and watches. They show a rapid growth in the number of clocks, and a somewhat irregular but distinct growth in the value of watches; the net imports during the year 1880 are, however, in both cases, somewhat below those of the year that immediately precede it.

Table II.—The first column of Table IV. gives the gross annual value of the exports of home produce, classed as "Clocks, Watches, and parts thereof." I thought it advisable to include all the information supplied by the Government Returns, and have therefore prepared this Table II. It is, however, in a sense unsatisfactory, owing to the fact that in many instances different countries were specified from year to year as importing the manufactures of Great Britain; but since 1871 there has been a greater degree of uniformity, although the subdivision is less complete; nevertheless, the table is in a high degree interesting, as showing who are our best customers, but it does not call for much special remark. The £20,038 sent to "Other Countries" in 1881 includes £2,187 in exports to Germany

The statistics prior to 1870 are singularly complete, as clocks and watches are given separately both by number and value. Comparing the line of totals at the bottom of the table with the first column in Table IV., it appears that about 60 per cent. of the exports are watches, the mean price of which fell gradually from £6·76 in 1867 to £4·76

II.—Distribution of Home Produce Exported.

Note.—Since 1870, the Exports of Home Produce are given only in Sterling Value under the heading "Clocks, Watches, and parts thereof."

COUNTRY.	1867.				1868.				1869.	
	Clocks.		Watches.		Clocks.		Watches.		Clocks.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.
		£		£		£		£		£
Argentine Confederation	...	...	193	2,518	...	...	213	1,436	...	...
Australia	4,248	4,985	...	...	5,168	5,588	...	...	7,864	7,202
Belgium	...	...	...	...	...	...	1,100	4,617	...	...
Brazil	...	...	196	2,489	...	...	95	1,026	922	1,511
British India—										
Bombay and Scinde	1,172	1,807	...	...	2,245	2,912	...	...	3,036	4,142
Madras	444	496	...	...	737	921	...	...	912	1,122
Bengal and Burmah	1,280	4,625	...	...	934	2,463	...	...	1,468	3,664
British North America	...	...	...	...	...	...	463	1,714	...	...
" Possessions in South Africa	515	982	...	...	461	454	...	...	492	1,019
Central America	...	...	...	...	...	...	...	...	...	...
Channel Islands	...	...	2,057	6,095	198	825	2,639	5,470	620	935
China	...	...	...	...	...	...	...	...	211	560
Chili	...	...	...	...	...	...	...	...	...	...
Cuba	...	...	...	...	...	...	...	...	...	...
Egypt	131	558	3,711	28,832	...	...	3,680	29,119	542	957
France	169	979	...	...	458	631	...	...	279	724
Hong-Kong	602	893	...	...	517	504	...	...	...	...
Malta	...	...	...	...	...	...	...	...	...	...
New Granada	...	...	397	2,921	...	...	917	4,142	...	...
Russia	...	...	...	...	...	...	...	...	...	...
Spain and Canaries	...	...	...	...	...	...	...	...	64	897
Straits Settlements	...	...	...	...	...	...	...	...	...	...
Sweden and Norway	...	...	...	...	...	...	...	...	...	...
Turkey Proper	...	...	...	...	...	...	...	...	...	...
United States—Atlantic	...	...	818	7,265	91	450	787	6,132	...	...
" Pacific	...	...	...	...	...	...	...	...	...	...
West Indies—British	...	...	...	...	...	...	...	...	...	...
" Foreign	...	...	...	...	...	...	...	...	...	...
Other Countries	2,898	5,100	1,668	11,021	2,966	5,823	1,022	6,376	2,674	3,746
Total	11,454	20,425	9,040	61,141	13,805	20,571	10,925	60,032	19.084	26,479
Mean Price	£1·78		£6·73		£1·49		£5·49		£1·38	

COUNTRY.	1870.				1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.
	Clocks.		Watches.									
	No.	Value.	No.	Value.								
		£		£	£	£	£	£	£	£	£	£
Argentine Confederation	...	...	143	2,013	2,632	2,563	...	...	...	...	...	...
Australia	3,703	4,714	...	...	4,923	15,145	43,150	41,231	33,129	38,328	38,397	32,741
Belgium	...	...	1,497	7,221	11,507	10,704	23,515	25,503	28,330	27,211	38,740	28,080
Brazil	4,215	3,265	612	3,955	6,554	4,496	6,208	...	4,298	...	...	2,945
British India—												
Bombay and Scinde	4,623	3,943	...	...	3,158	2,863	4,559	5,634	5,442	6,193	2,951	3,328
Madras	731	976	...	...	...	...	2,166	1,463	2,165	1,360	1,470	1,815
Bengal and Burmah	1,085	3,598	...	...	...	3,919	4,079	5,011	6,708	5,532	6,652	6,809
British North America	504	605	192	1,013	5,482	3,308	3,827	3,470	...	...	...	...
" Possessions in South Africa	607	752	188	1,151	...	8,098	11,644	10,994	9,479	8,742	7,911	9,085
Central America	...	...	...	...	...	...	...	...	...	...	...	...
Channel Islands	...	...	1,452	4,101	...	...	...	...	...	...	...	...
China	...	...	...	...	...	...	...	...	...	...	...	...
Chili	384	519	372	1,897	2,027	...	...	...	...	...	...	...
Cuba	...	...	212	1,740	...	...	...	...	...	...	...	...
Egypt	198	803	8,383	37,741	24,630	28,271	9,477	...	1,898	1,372	1,629	662
France	...	...	...	...	2,402	4,714	6,489	6,067	6,374	9,010	9,845	10,629
Hong-Kong	...	...	...	...	...	...	...	...	...	...	...	...
Malta	...	...	215	1,039	...	...	...	...	...	...	...	...
New Granada	...	...	1,166	12,221	15,546	11,530	9,370	...	878	2,334	634	681
Russia	...	...	...	...	3,599	...	...	...	...	...	...	...
Spain and Canaries	...	...	...	...	...	...	...	...	...	...	...	...
Straits Settlements	625	510	...	...	...	...	...	...	...	...	...	...
Sweden and Norway	...	...	...	...	3,108	8,053	3,136	4,146	...	...	...	...
Turkey Proper	...	...	739	1,814	2.113	4,061	...	...	...	...	...	...
United States—Atlantic	...	...	1,443	7,849	59,936	14,606	23,319	12,596	16,636	30,079	21,275	23,152
" Pacific	...	...	...	...	37	66	...	90	349	...	...	...
West Indies—British	...	...	204	908	...	...	...	...	...	...	...	...
" Foreign	...	...	...	...	7,264	...	...	...	...	...	...	...
Other Countries	4,233	4,731	2,442	6,972	17,189	19,909	27,150	30,589	27,788	26,737	25,446	20,963
Total	20,908	24,416	19,280	91,635	172,107	142,306	178,089	146,794	143,494	156,898	154,950	140,390
Mean Price	£1·16		£4·76									

III.—DISTRIBUTION OF FOREIGN CLOCKS EXPORTED.

Distribution of Foreign Watches Exported is not given at all in the returns, neither is that of Clocks during the years 1867-70.

...STRALIA.		BRITISH INDIA.		STRAITS SETTLEMENTS.		SWEDEN AND NORWAY.		OTHER COUNTRIES.		TOTAL.		Mean Price.
...	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.	
	£		£		£		£		£		£	£
	...	...	...	...	...	...	...	...	...	10,372	5,843	0·56
	...	...	...	...	...	...	..	...	...	5,827	7,962	1·36
	...	...	...	...	...	...	...	...	...	7,650	7,013	0·92
	...	...	...	...	...	...	...	...	...	12,124	9,454	0·78
7	3,220	4,775	3,144	917	757	...	...	6,816	5,343	16,515	12,464	0·76
5	5,121	6,361	4,781	1,510	1,323	4,714	2,532	7,708	7,047	25,468	20,804	0·81
9	6,493	1,453	1,614	1,322	1,123	3,204	1,848	7,447	8,005	19,825	19,083	0·96
3	7,272	4,533	3,522	1,984	1,471	3,653	2,117	7,638	6,112	25,121	20,494	0·81
6	6,992	2,892	2,434	1,425	1,214	7,061	3,959	8,366	6,377	27,910	20,976	0·75
0	8,202	2,769	2,218	...	...	22,790	11,744	9,679	7,380	44,458	29,544	0·66
8	8,032	4,240	2,533	...	...	25,913	7,519	13,866	9,027	51,627	27,111	0·52
1	7,700	7,465	4,884	...	...	14,713	4,180	23,565	12,866	56,794	29,630	0·52
8	7,183	8,359	4,395	...	...	11,256	3,358	40,060	23,404	69,233	38,340	0·55
3	7,056	16,843	8,321	9,737	4,702	12,386	6,427	94,399	46,990	150,218	73,496	0·49

e mean price of English clocks exported out the same proportion. Our best Australia; Belgium generally comes he large amount of our exports to the es will be a matter of surprise to many. 7.—This gives information similar to ed in Table II, but in regard to foreign rted from this country. The returns e such details in regard to foreign cept in one or two isolated cases, which ord in the notes to Table IV. These w that our exports of foreign clocks teadily increasing for many years past, there was an extraordinary expansion, representing both number and value, y double those of the preceding year.

One feature of this Table III. to which I would draw attention, is the large export of foreign clocks to Sweden and Norway from this country; it is certainly unexpected. In the exports to "Other Countries" in 1879 are included 1,049 foreign clocks (valued at £4,920) sent to France, and 14,079 (valued at £7,066) sent to China. Exports during 1880 to countries not provided for in the Table (which I have included under "Other Countries") are:—

	No.	Value.
China	31,878	£11,810
France	1,613	6,162
Hong Kong..	24,527	11,241
Japan	19,329	8,125

IV.—SUMMARY OF EXPORTS.

HOME PRODUCE.	FOREIGN CLOCKS.		FOREIGN WATCHES.	TOTAL.
	Number.	Value.		
£		£	£	£
98,697	10,372	5,843	3,291	107,831
93,997	5,827	7,962	3,515	105,474
121,258	7,650	7,013	3,114	131,385
146,186	12,124	9,454	29,257	184,897
172,107	16,515	12,464	59,900	244,471
142,306	25,468	20,804	8,732	171,842
178,089	19,825	19,083	6,479	203,651
146,794	25,121	20,494	3,942	171,230
143,494	27,910	20,976	7,479	171,949
156,898	44,458	29,544	19,397	205,839
154,950	51,627	27,111	24,043	206,104
140,890	56,794	29,630	30,600	201,120
155,130	69,233	38,340	30,315	223,815
156,817	150,218	73,496	26,017	256,330

—Table IV., giving an annual summary rts, is convenient for reference, and is dex of the state of the English trade tatistics afford. There is a decided rise in the column headed "Home indeed the last figure, that for 1880, is ,512 above the mean of the previous ars. The exports of foreign produce may, from a commercial point of view, be regarded as forming part of the home trade; they also show a decided rise; we are therefore safe in concluding that the English trade is certainly not in such a depressed state as some would have us believe, and 1880 stands out as the one in which a far greater amount of foreign trade was done than in any previous year.

The returns add the following particulars, which I will give for the sake of completeness, although they are of no special moment:—

Foreign Watches Exported.

1871.	To the United States	£47,606
	,, Other countries	12,294
1876.	,, Belgium	17,169
	,, Other countries	2,228
1877.	,, Belgium	21,731
	,, Other countries	2,312
1878.	,, Belgium	26,612
	,, Other countries	3,988
1879.	,, Belgium	21,302
	,, Other countries	9,043
1880.	,, Belgium	20,274
	,, Other countries	5,743

Table V.—As, prior to 1870, numbers as well as value were always given in regard both to imports and exports, I have added this table, which consists mainly of "Mean Prices" calculated from these returns. The mean price of both clocks and watches of home manufacture exported fell regularly as already mentioned; and full details are given of the manner in which other prices varied, as well as all particulars of the numbers of the several articles imported and exported.

The figures in regard to chronometers exported cannot be taken as in any way an index of the amount of our foreign trade in that branch, for many vessels obtain their supply when in an English port, and this would naturally not be included as an "export."

The last column of the table gives the average mean prices during the four years under consideration, and, taken in conjunction with the preceding tables, they constitute the sole means at our disposal for ascertaining approximate numbers in recent years. Thus, taking £5·41 as the average price of an exported English watch, and remembering the fact, already mentioned in speaking of Table II., that about 60 per cent. of the total exports are watches, it appears from the second column of Table IV. that, for example, in 1880, we exported about £100,000 in English watches, and that their number was approximately $\frac{100,000}{5 \cdot 41}$ or 18,480. The mean price of an imported foreign watch being taken to be £1·60, it appears from the last column but two of Table I., that in the same year we imported for home consumption $\frac{401,646}{1 \cdot 6}$ or 251,030 foreign watches, to which we may probably add about 20,000 of American manufacture that are not included in the returns. Now, the last census showed that there were 23,766 men and 749 women engaged in the clock and watch trade in the United Kingdom, or a total of 24,515. Thus it appears that we actually did not export one watch per head of the watchmaking population, and imported about ten. It would perhaps have been fairer to compare the population with the returns for 1871, the year of the Census. The export of home watches was then about $\frac{115,000}{5 \cdot 41}$ or 21,250, and the net imports of foreign watches $\frac{409,514}{1 \cdot 6}$ = 255,970, and the proportion therefore is even worse (as 1 is to 12),

Table VI.—This table gives the returns of watch cases hall-marked at the several Assay Offices; numbers that have hitherto bee[n] as an index of the state of trade in thi[s] But a little consideration will suffice to [...] they are subject to much uncertainty, an[d] be fallacious when used for such a pu[rpose] many cases are imported in order to r[eceive the] hall-mark, and subsequently enclose for[eign] works. Their number is very uncerta[in] will be seen from the information suppli[ed by the] Chester Assay Office authorities that sin[ce] 1876, when cases appear to have been fir[st sent] to England for this purpose, they have [averaged] about 13,000 per annum at Chester, an[d] not more than 7·5 per cent. have been g[old. This] latter fact seems to point to the concl[usion that] the gold cases marked would afford a f[airer index] of our trade than the total number, [and if this] be accepted, the returns for the last [...] certainly indicate a steady fall in the [...] At the same time it is well to note tha[t] from the Chester returns alone, the [...] silver cases of home manufacture sho[w a] large increase, and a gradual decline o[f] the number of foreign cases marked at [...] justifies the conclusion that the diminu[tion in] total numbers is not entirely borne by [...] trade. Further uncertainty is occasio[ned by the] fact that many English cases are fitted w[ith foreign]-made movements, and we have no mea[ns of ascer]taining how their number varies from y[ear to year].

And there is yet another source of [...] in these hall-marking returns as an in[dex of the] watch trade. The Birmingham Office [...] cases by gross weight, and the numbe[r is] calculated on the assumption that each [...] about 1½ oz.; but this is obviously lia[ble to con]siderable error, more especially if ma[ny ...] cases are included, as they never reach t[...]

There is one fact, then, which the [...] have been able to collect bring in[to] prominence; it is the utter impossibili[ty of draw]ing any reliable conclusions as to the [...] English trade from these returns of [the] Assay Offices. The year 1879, affords [a remark]able instance of this fact. In com[paring the] number of cases marked at Goldsmiths' [Hall in] that year, with those of years immed[iately pre]ceding it, the *Horological Journal*, i[n ...] 1880, observed:—"Short of absolute [...] the English watch manufacture certai[nly ...] as low a point as possible during th[e year just] passed." Now, in the light of t[he Customs] returns, what are the facts? The [...] (Table I.) were £2,500 above the ave[rage of the] previous nine years, and the export[s of home] produce (Table IV.) were £1,600 above [...] for the same period.

The returns of the total export trade[, ex]clusive of foreign clocks and watches, gi[ven in Table] IV., afford still more conclusive evid[ence of the] relative prosperity of 1879. They reac[h a total] of £223,815, considerably in excess of [...] any previous year, except 1871, when [...] were abnormally expanded by £47,60[6 of foreign] watches sent to America. And the ex[ports of] that year are even exceeded by those of [1880, which] shows a gross increase of £32,515 over [...] owing to the foreign clocks re-exp[orted being] largely in excess, although there is a [...] in home produce.

V.—Further Particulars in regard to the Years 1867—1870.

EXPORTS.	1867.	1868.	1869.	1870.	Average of the Four Years.
Price	£1·78	£1·49	£1·38	£1·16	£1·41
n Price	£6·76	£5·49	£5·05	£4·76	£5·51
-Number	69	85	121	90	
Value	£1,894	£2,362	£3,098	£2,754	
Mean Price	£27·45	£27·79	£25·60	£30·6	£27·69
ch Movements—Value	£15,237	£11,082	£9,085	£27,381	
Price	£0·56	£1·36	£0·92	£0·78	£0·84
l: Number	149	180	287	2,163	
Value	£1,357	£2,134	£2,076	£18,878	
Mean Price	£9·11	£11·85	£7·23	£8·73	£8·73
er, &c.: Number	872	1,068	1,106	7,889	
Value	£1,934	£1,381	£1,038	£10,879	
Mean Price	£2·22	£1·29	£0·94	£1·34	£1·85
'oreign Watches exported	£3·22	£2·80	£2·24	£2·91	£2·86
	1,021	1,248	1,893	10,052	
IMPORTS.					
—Number	658	870	1,355	17,852	
Value	£3,342	£4,654	£7,200	£80,289	
Mean Price	£5·11	£5·34	£5·31	£4·49	£4·63
er Watches—Number	3,988	3,193	4,979	97,555	
Value	£4,906	£4,010	£6,962	£141,434	
Mean Price	£1·23	£1·25	£1·39	£1·45	£1·44
of Watches	4,641	4,063	6,334	115,407	
	£1·77	£2·13	£2·23	£1·92	£1·94
—Number	23,480	24,145	29,314	22,494	
Value	£69,580	£73,987	£78,034	£52,202	
Mean Price	£2·90	£3·06	£2·66	£2·32	£2·75
er Watches—Number	90,807	90,894	93,671	71,798	
Value	£108,460	£109,690	£105,023	£76,116	
Mean Price	£1·19	£1·20	£1·12	£1·06	£1·15
of Watches	114,287	115,039	122,985	94,292	
	£1·56	£1·68	£1·48	£1·36	£1·51
—Number	247	390	66	2,452	
Value	£1,747	£2,947	£1,002	£9,729	
Mean Price	£7·07	£7·55	£15·18	£3·97	£4·89
er Watches—Number	522	1,785	327	10,986	
Value	£1,148	£3,568	£986	£12,650	
Mean Price	£2·20	£1·99	£3·01	£1·15	£1·35
of Watches	769	2,175	393	13,438	
	£3·76	£2·99	£5·06	£1·66	£2·01
r	24,380	25,405	30,735	42,798	
	£74,669	£81,588	£86,236	£142,220	
'rice	£3·06	£3·21	£2·80	£3·32	£3·12
'umber	95,317	95,872	98,977	180,339	
'alue	£114,514	£117,268	£112,968	£230,200	
lean Price	£1·21	£1·22	£1·13	£1·27	£1·21
mber	119,697	121,277	129,712	223,137	
an Price	£1·58	£1·64	£1·53	£1·67	£1·60

VI.—Watch-cases Hall-marked.

Gold. Birmingham.	Gold. Chester. English.	Gold. Chester. Foreign.	Gold. London.	Gold. Total.	Silver. Birmingham.	Silver. Chester. English.	Silver. Chester. Foreign.	Silver. London.	Silver. Total.	Grand Total.
...	7,499	...	25,501	33,000	8,726	17,023	...	97,570	123,319	156,319
...	11,446	...	24,952	36,398	7,834	17,345	...	85,995	111,174	147,572
2	10,858	...	25,210	36,070	8,374	15,583	...	83,439	107,396	143,466
42	12,050	...	24,881	36,973	8,342	14,763	...	86,260	109,365	146,338
...	12,549	...	25,780	38,329	9,018	18,395	...	96,543	123,956	162,285
...	12,919	...	28,441	41,360	13,608	28,993	...	103,271	145,872	187,232
2	12,503	...	30,894	43,399	17,106	36,423	...	108,971	162,500	205,899
3	11,987	...	31,234	43,224	22,448	34,564	...	109,814	166,826	210,050
6	11,595	...	32,888	44,489	21,648	25,778	...	112,323	159,749	204,238
42	10,728	395	34,844	46,010	24,930	24,618	10,224	119,394	179,166	225,176
113	10,189	1,000	31,212	42,579	37,834	24,651	20,704	115,123	198,312	240,891
323	9,429	571	30,161	40,484	32,520	43,345	12,655	101,017	189,537	230,021
600	7,799	1,201	24,558	34,158	30,692	39,262	10,738	92,730	173,422	207,580
634	7,191	1,309	21,498	30,632	40,030	39,653	8,347	87,327	175,357	205,989

But these returns prove another point which is less satisfactory. While they show that our export trade in 1879 and 1880 were above the average of preceding years, they also show that the rapidly increasing home demand is, at least to a very large extent, supplied by foreign makers, so that our credit abroad actually appears to be better than in this country.

The cause of the difference of £1·26 between the prices of imported and exported foreign watches is not clear; it is, however, probably in the main, due to the fact I have already mentioned, that many of the latter come to this country to be cased; in instituting a comparison, therefore, with those of home manufacture, it would be fairer to take the two export prices rather than the import and export.

It is unfortunate that more recent details in regard to the mean price are not accessible, but, accepting those already given for 1867-1870, is it fair to conclude that the average English watch exported is so much superior to the average foreign watch, as to justify so marked a difference in price as there is between £5·41 and £2·86? Few will, I think, be prepared to maintain that it is not open to question, and however hopeful statistics may be, the trade cannot be said to be in a satisfactory condition until either such a difference is justified, or the price is reduced.

In considering such a subject, there are many circumstances to be taken into account. High quality must always depend largely on the education of the workman, and the honesty with which he does his work; moderate price must be aimed at by systematising the manufacture, and will always be in a great measure influenced by the amount of production.

(*To be continued.*)

MISCELLANEOUS.

CITY AND GUILDS OF LONDON INSTITUTE.

The first stone of the Central Institution of the City and Guilds of London Institute for the Advancement of Technical Education, was laid on Monday, 18th inst., by his Royal Highness the Prince of Wales, who was accompanied by the Princess of Wales. The building will have a piece of land in the Exhibition-road, South Kensington, between the Indian Museum and the Albert Hall, granted to the institute at a nominal rent by the Commissioners of the Exhibition of 1851.

The Lord Chancellor said—May it please your Royal Highness, I have to express, on behalf of the council of the institute of which I have the honour to be chairman, our gratification at your presence here to-day to lay the foundation stone of the Central Institution of the City and Guilds of London Institute for the Advancement of Technical Education, and, at the same time, to offer our grateful thanks to her Royal Highness the Princess of Wales for the interest which she has been graciously pleased to manifest in our work by accompanying your Royal Highness on this occasion. The council and the governors of the institute have heard with unmixed satisfaction that your Royal Highness has graciously consented to become the President of this association, the objects of which are the improvement of the industrial and commercial pursuits of this country, by affording facilities to apprentices, foremen, ma[illegible] works, and manufacturers, to become practi[illegible] quainted with the principles of science and ar[illegible] application to industrial operations. The inst[illegible] grown up by the united efforts of a few of th[illegible] guilds of London, which, having combined purpose of assisting in the advancement of education, obtained later on the help of [illegible] poration of London and of other livery co[illegible] 22 of which, including nine out of the [illegible] guilds, are represented on the council [illegible] institute, and jointly contributed nearly [illegible] annually to its funds. At first, the effor[illegible] association were confined to the encourag[illegible] technical education in schools and colleges i[illegible] and elsewhere; but latterly the institute [illegible] enabled to establish and organise schools of it[illegible] technical instruction, and also to assist in the [illegible]ment of technical education in a large number in the United Kingdom. This institution wi[illegible] established as a rival to any other existin[illegible] learning; least of all to the excellent schools in this neighbourhood, which for some years [illegible] been the means of offering to hundreds of yo[illegible] and women a knowledge of the principles o[illegible] and art. The aim of this institution wi[illegible] supplement the teaching of those schools, b[illegible] instruction in the practical application of and art to the trades and industries of the [illegible] and by cultivating and endeavouring to [illegible] inventive genius. As President of the Roy[illegible] mission for the Exhibition of 1851 this insti[illegible] already greatly indebted to your Royal High[illegible] the other members of the Commission, for the[illegible] a nominal rental of the valuable plot of ground [illegible] this institution is to be erected. The institute [illegible] fully sensible of its obligations to her Majest[illegible] missioners, without whose kindly assistance th[illegible] of this college might possibly have been del[illegible] gives me great pleasure to be enabled to add t[illegible] seemed fit to her Majesty to recognise on this the eminent services of Mr. Bramwell, t[illegible] fatigable chairman of the executive com[illegible] the institution, by signifying her Majesty's intention of conferring upon that gentle[illegible] honour of knighthood. It is anticipated [illegible] cost of this building, when fully equipped [illegible] apparatus and appliances needful for tech[illegible] struction, will not fall far short of £75,000. [illegible] sum £31,000 has been already subscribe[illegible] worshipful companies of Fishmongers, G[illegible] Clothworkers, and Cordwainers; the gran[illegible] Drapers' Company having been appropriate[illegible] Finsbury College; and it is expected that abou[illegible] will be saved from the annual income of the during the building of this college. The therefore, after paying the amount which is have at their disposal only an estimated sum £55,000, and they look to the liberality of t[illegible] Companies, both of those who have and of t[illegible] have not as yet subscribed to the fund institute, to make good the balance of £20,000 the building of this college may be com[illegible] once and as a whole, in strict accordance [illegible] plans. It is confidently hoped that the presen[illegible] Royal Highness and of her Royal Highness the of Wales here to-day, sanctioning and appr[illegible] objects for which this institute has been foun[illegible] for the promotion and further development [illegible] this central institution is to be erected, and proof of her Majesty's gracious approval whi[illegible] been enabled to announce, will stimulate the Guilds of London liberally to bestow their fu[illegible] the work which they have so wisely and ho[illegible] inaugurated, so that this important edifice, stone of which is to be now so auspiciously [illegible] be worthily established and adequately endow[illegible]

is **Royal Highness the Prince of Wales** then said,— Lord Chancellor, my Lords, Ladies, and Gentle- ,—I thank you for your address, and beg leave to re you that it gives me much satisfaction to attend to-day, to lay the foundation stone of an institution :h gives such forcible expression to one of the most ortant needs in the education of persons who are ined to take part in the productive history of this ntry. Hitherto English teaching has chiefly relied raining the intellectual faculties, so as to adapt men pply their intelligence to any occupation of life to :h they may be called; and this general discipline of mind has, on the whole, been found sufficient, until nt times;. but during the last 30 years, the compe- n of other nations, even in manufactures which once e exclusively carried on in this kingdom has been y severe. The great progress that has been made in the ns of locomotion, as well as in the application of steam the purposes of life, has distributed the raw materials industry all over the world, and has economised e and labour in their conversion to objects of utility. er nations which did not possess in such abundance Great Britain coal, the source of power, and iron, the nce of strength, compensated for the want of raw erials by the technical education of their industrial ses, and this country has, therefore, seen manu- tures springing up everywhere guided by the ned intelligence thus created. Both in Europe in America, technical colleges for teaching, not the tice, but the principles of science and art involved particular industries, had been organised in all the ing centres of industry. England is now thoroughly e of the necessity for supplementing her educational itutions by colleges of a like nature. Let me remind that the realisation of this idea was one of the most ished objects which my lamented father had in view. r the Exhibition of 1851, he recognised the need of nical education in the future, and he foresaw how ult it would be in London to find space for such ums and colleges as those which now surround the on which we stand. It is, therefore, to me a liar pleasure that the Commissioners of the bition, of which I am the President, have been to contribute to your present important under- g, by giving to you the ground upon which the nt college is to be erected, with a sufficient reserve d to ensure its future development. Allow me, in usion, to express the great satisfaction which I rience in seeing the ancient guilds of the City of lon so warmly co-operating in the advancement of ical instruction. I am aware that several of them for some time past in various ways separately uraged the study of science and art in the metro- , as well as in the provinces; and it is a noble t on their part when they join together to establish ited institute with the view of making still greater more systematic endeavours for the promotion of branch of special education. By consenting at request to become the president of this institute I it may be in my power to benefit the good work, that our joint exertions, aided, I trust, by the con- ed liberality of the City and Guilds of London, may e to be an example to the rest of the country to the intelligence of industrial communities, so that, the increasing competition of the world, England retain her proud pre-eminence as a manufacturing on.

r. F. J. Bramwell then presented to his Royal hness a medal, which had been struck at the Royal t commemorating the laying of the stone, bearing he obverse the shields of all the contributing Com- es, and on the other side a record of the event to place that day.

r Sydney H. Waterlow handed to his Royal High- , who placed it in a cavity in the stone, a glass and l case containing the smaller weights of the country, coins, and a copy of *The Times*, *Nature*, and the *City Press*; also a medal and a document recording the laying of the stone.

Mr. Norman Watney having presented to his Royal Highness a handsome silver and ivory trowel, the column of polished granite was then lowered into its proper position.

The Prince of Wales then said,—In the name of the Father, the Son, and the Holy Ghost, I declare this stone to be duly laid.

THE MINT.

The eleventh annual report of the Deputy-Master of the Mint has lately been issued, and the following is an abstract of its contents:—

The demand for bronze coin having been far below the average, it has not been necessary to provide for the execution of any part of the coinage by contract during the year, but the Department has been fully occupied in meeting the demand for gold and silver coin, and in supplying three unimportant coinages to colonies. Three other colonial coinages, of larger amounts, which pressure of work did not permit the Mint to undertake, were executed by contract under the supervision of the Department. The requirements of the Bank of England were met by a coinage of rather more than £4,000,000 of gold, or about £1,000,000 less than the average, but the coinage of silver, which has exceeded £744,000, has been larger than that of any year since 1874. The coinage of bronze, on the other hand, has barely exceeded £19,000, as against an average of £42,600 in the preceding five years.

The coins struck during the year 1880 were of twenty-three different denominations. The total number of pieces struck at the Mint was 26,870,533, as against 30,050,311 in 1879, and their value, real or nominal, £4,926,255 15s. 8d. The total number of British coins struck during the year was 25,812,033, and their value was as follows:—Gold, £4,154,604 10s.; silver, £744,829 8s. 11d.; bronze, £19,471 16s. 9d.

GOLD COINAGE.

The coinage of gold commenced in December, 1879, and was concluded in July, 1880. The amount coined in 1879 was insignificant, but during the first six months of 1880, a sum of rather more than £4,150,000 was delivered to the Bank of England in sovereigns and half-sovereigns, and the total value of the coinage was brought up to £4,185,120. This is the largest gold coinage executed since 1876, when the amount issued in the year was £4,700,000. During the intervening period of three years, owing to the general depression of trade, the annual average demand for gold coin from the Mint has been but little more than £1,000,000, the importations of sovereigns issued by the Sydney and Melbourne Mints having each year been sufficient to make up the quantity of new coin required by the Bank of England. During the year 1880 the amount of Australian gold coin imported was £2,377,000, as against the following amounts in the preceding five years:—

1875	£2,726,000
1876	2,075,000
1877	3,748,000
1878	2,773,000
1879	1,617,000

SILVER COINAGE.

The silver coinage of the year, as already stated, was considerably above the average. The amount of coin struck was £744,829, as against £567,125 in 1879, and £614,426 in 1878, and the amount issued £709,093. The issues consisted of £190,700 sent to the Bank of England, £122,000 to the Bank of Ireland, £73,500 to Scotch banks, and £308,940 to colonies; £13,250 shipped in aid of Treasury chests abroad, and £500 in threepences supplied direct to banks and private persons. As in

ormer years, applicants for small sums in threepences were referred to London banks which had intimated that they held a stock in excess of their own requirements, and the amount sold to individuals, therefore, was inconsiderable; but the total amount issued, nevertheless, reached £23,050. This amount, though less than the issues of 1879 and 1878, which were £37,220 and £30,425 respectively, shows that the demand for threepences is still very large. It may be mentioned in this place that fourpences, none of which have been coined since 1856, continue to be withdrawn in considerable quantities, and will shortly no doubt almost entirely disappear from circulation. The nominal value of the fourpences withdrawn during the past year was about £4,000, and in 1879 was £3,600, so that the number of these pieces in circulation has been reduced in two years by not less than 456,000.

The half-crowns issued during the year have been of the nominal value of £164,920, and the total amount of these coins issued since 1874, when their coinage was resumed, has been £992,070.

There has been a decided increase in the demand for silver coin in England and Wales during the past year. In the latter part of 1878, and during the greater part of 1879, owing to the general contraction of trade and the depression of agriculture, large quantities of coin were received back by the Bank from the public; but, in 1880, the issues again largely exceeded the amounts received, and the silver currency, therefore, may be considered to have resumed its normal condition. The amount of worn silver coin withdrawn from circulation, £250,000, continues to be large, and shows that the renewal of the coinage progresses satisfactorily.

In Scotland and Ireland also, the demand for silver coin has been considerable.

Notwithstanding the large issues of 1879, which amounted to £298,470, the amount of new coin shipped to the colonies has during the past year shown no signs of diminution. The demand for silver coin throughout the colonies in which the Imperial coinage is current has been greatly stimulated by the arrangements made at the beginning of 1879, under which the Mint was authorised by their Lordships to pay all expenses connected with the carriage of new silver and bronze coin to, and of worn silver coin from, British dependencies.

In connection with the withdrawal of worn silver coin from circulation, the "Loss by Exchange" for the year 1880 was £58,696, as against £54,702 in 1879, although the amount of coin sent in for re-coinage in 1880 was only £485,015, as against £495,055 in the previous year.

The average market price at which standard silver has been purchased for coinage during the year 1880 has been 52¼d. per ounce, so that, as the rate at which silver coin is issued by the Mint is 66d. per ounce, the seignorage accruing to the State has been at the rate of 13¾d. per ounce, or 26¾ per cent.

Bronze Coinage.

The bronze coinage of the year, as already mentioned, has been comparatively small, having only amounted to £19,400, and the issues, though exceeding this sum by £9,000, have still fallen short of those 1879 by no less than £10,000. It would appear, therefore, that the very large issues made since the first introduction of the bronze coinage in 1860, which amounted up to the end of last year to £1,475,608, have at length begun to affect the demand.

Of the amount issued in 1880, £19,640 consisted of pence, £6,058 of half-pence, and £2,772 of farthings, as against issues in 1879 of £28,050 in pence, £7,735 in halfpence, and £3,185 in farthings. The demand for each denomination of coin, therefore, has sensibly diminished.

The bronze metal purchased for coinage during the year amounted, as in 1879, to 100 tons, in bars ready for coinage.

The result of the general account of the expenses and receipts of the past year, as in the two previous years, has been a loss, but it is satisfactory to n[illegible] whereas the excess of expenses over receipts [illegible] 1878, £51,543, and in 1879, £27,955, it was [illegible] reduced to £7,658. It might have been hoped, [illegible] that as the purchases of silver bullion for coinage, are generally the principal source of profit, were as large in 1880 as in 1879, the receipts mig[illegible] more have exceeded the expenditure; but the the withdrawal from circulation of worn silver its nominal value was again very large, and [illegible] counter-balanced the profit on the conversion bullion into new coin, while the profit on the coinage was slightly less than in 1879, and the [illegible] on a gold coinage of £4,000,000, which came i[illegible] of payment during the year, formed a further loss. The transactions of the Mint, however the nine years which have elapsed since a "P[illegible] Loss Account" was first compiled in its pres[illegible] still show an annual profit of £17,920; and i[illegible] expected that, as trade revives, the causes which favourably affect those transactions will cease

Counterfeit Coining.

The only counterfeit of special interest brou[illegible] the notice of the Mint during the past ye[illegible] spurious sovereign of platinum found in circ[illegible] Sydney, and forwarded by the Deputy-Mast[illegible] Sydney Mint, with a report of Dr. Leibius, [illegible] that branch. Platinum counterfeits are wel[illegible] but the specimen in question bore traces of [illegible] impression, and it appeared probable at first [illegible] a genuine Russian platinum coin had been [illegible] and gilt. After careful examination, howev[illegible] found that on the obverse of the counterfeit t[illegible] escutcheon on the reverse of a Spanish Isab[illegible] escudo piece, was clearly traceable, the fig[illegible] being also visible. It became evident, ther[illegible] the spurious sovereign had originally been [illegible] feit of the Spanish gold coin.

OBITUARY.

Lord Hatherley, F.R.S.,—Lord Hatherl[illegible] death, at the age of 80, took place on the 1[illegible] his house in Great George-street, Westmins[illegible] member of the Society from 1859, in which y[illegible] (then Vice-Chancellor Sir William Page W[illegible] elected a Vice-President of the Society fo[illegible] time. In 1860 he took the chair, when a[illegible] "Science in our Courts of Law," was rea[illegible] Angus Smith, and from that time till 1869, finally retired from the Council, he took an a[illegible] in the work of the Council and the committ[illegible] Society. In recent years he was sever[illegible] asked again to serve on the Council, but he on the ground that his increasing years, w[illegible] brought no leisure, brought a diminished ca[illegible] work, and he was always reluctant to allow to appear when he was unable to take a sha[illegible] work. But, though he had thus retired from a[illegible] vice to the Society, he was always ready to assist counsel and advice when it was required, and o[illegible] occasions the Society's interests thus profited b[illegible] The full accounts of Lord Hatherley's person[illegible] which have appeared in the daily and week[illegible] papers, render it unnecessary to give any de[illegible] in this *Journal*; nor would it be becoming h[illegible] more than allude to the reverence and affection he was held by all who knew him. It may [illegible] esting to say that he at all times took a kee[illegible] alike in literary and in scientific progress. He [illegible] self an author, his principal work being "The C[illegible] of Scripture," published in 1867. As far bac[illegible] he was elected a Fellow of the Royal Societ[illegible] has several times served on its Council.

THE SOCIETY OF ARTS.

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·the Society should be addressed to the Secretary street, Adelphi, London, W.C.

NOTICES.

RNITURE EXHIBITION.

on of Works of Art Applied to
nnection with the Exhibition of
e Royal Albert Hall, is now open
ransferable season ticket will be
ber of the Society on application
A ticket, to admit two persons,
present *Journal*.

NGS OF THE SOCIETY.

ANTOR LECTURES.

TCHMAKING,

y Edward Rigg, M.A.

URE II.—(*Continued.*)

e I shall endeavour to explain systems of manufacture in this tries, but would first say a few design of the watch. This is a only practical watchmakers can ; there certainly are faults in many that even a non-technical observer ve noticed. They are most marked d a full-plate watch, a watch, that several moving parts are held in o circular plates, the balance sition external to the rest of the icular form has come to be known world as the "English watch," and h only one essential change, namely, e escapement, for the last 200 years, It is, at first sight, a matter of re consider the changes that have ll the sciences and the mechanical ece of mechanism, important as it of society, should have so long nary, or nearly so. This fact has ferred to in the first lecture, and en there given why we should not much radical change in its design. so much appear to be occasion for new escapements, &c., as for the simplifying of the watch as it already exists; and, above all, there is the need of replacing vague rules of thumb by definite principles of construction, and of taking advantage to the utmost limit, in practice, of the aid which theory has to offer.

Where is the necessity for making the English watch so much thicker than others? Why are we obliged to have a watch that involves opening the face to set to time? And why does a common Swiss or French watch often present a far more attractive external appearance than many of those of English make at twice the price? The faults in the design of the mechanism itself are quite as numerous, but I will not now stay to enumerate them, and to those who care to inquire into them would commend a suggestive article by Mr. Glasgow,* published only last year in the *Horological Journal*.

The criticisms that have to be met apply in the main to full-plate watches. This form has been gradually abandoned, in the case of high-class work, in favour of the half and three-quarter-plate, in which a portion of the top-plate is cut away, so that the balance may be in the same plane with or even below it, thus diminishing the thickness by about an eighth of an inch. The change was somewhat distasteful to the public at first, and there seems still to be an extraordinary amount of indirect opposition to it on the part of many workmen connected with the trade. Thus an escapement to a three-quarter-plate watch generally costs twice as much as for a full-plate watch, and a similar distinction is made in several other stages. But there seems no sufficient reason for so great a difference. It is, doubtless, in part owing to the fact that, as a rule, the three-quarter-plate watch is of a better quality, and work on it is, therefore, naturally more highly paid; but there appears to be no reason, unless public prejudice be considered one, why all qualities, even the lowest, should not be of similar design. Indeed, in Switzerland, the very cheapest watch manufactured is on the three-quarter-plate model.

The manufacture of a watch involves a very great number of distinct operations, each of which requires considerable knowledge and skill on the part of the workman.

During the sixteenth and seventeenth centuries, when pocket timekeepers were first introduced, the watchmaker, as a rule, himself made all the parts of both watch and case, employing only a few simple tools. But since that period the work has become gradually more and more subdivided, and each workman, by constantly confining himself to the making of one special object, is enabled, as in all handicraft, to make it both more rapidly and more accurately. At the same time, the simple tools of the early makers have been more or less elaborated, so as to abridge and facilitate the work—at times, indeed, to such an extent that the skilled workman himself is rendered unnecessary.

These latter machines are of comparatively recent introduction, and the collection of tools which I hope to exhibit on Monday next, show how much of the work of an ordinary watchmaker depends on his manual skill. But in recent years machine-tools have come more and more into use, and these have naturally tended towards the in-

* *Horological Journal* (1880), xxii., p. 92.

troduction of a factory system, in place of what was essentially a home manufacture.

Thus three systems are now possible for the production of watches on a large scale :—

(1.) Each workman, becoming an adept at one or more special trades, remaining independent, and working for a number of employers.

(2.) Workmen in all the trades being collected together in one large factory, which is thus in a condition to produce finished watches from the rough metal.

(3.) A combination of these two systems.

I propose to consider these separately, and will endeavour to point out some of their relative merits, as bearing on the English watch-making industry. The first is that mainly practised in England, Switzerland, and France. A frame, containing the barrel, fusee (if any), centre, third and fourth wheels, all with their teeth cut and pinions attached, and certain other portions in the rough, constituting a *movement*, is manufactured, say at Prescot, in Lancashire, and delivered to the Clerkenwell or Coventry manufacturer. After numbering it, he sends it, or the requisite portion, in succession, to the dial-maker, case-maker, escapement-maker, finisher, gilder, fusee-cutter, jeweller, &c., and, finally, to the examiner, who adjusts the balance-spring, and regulates the watch, returning it to the manufacturer. In all, at least 40 artificers aid in the production of a lever watch, but of these the most responsible is the finisher, whose duty it is to turn the pivots, preparing everything for the gilder, determining the positions of all the wheels, so that the train runs freely, drilling all pivot-holes, except those of the escapement, &c., but he does not, as his name would suggest, finish the watch. And the examiner is called upon to find out any faults in his predecessor's work, see that they are corrected, fix the balance-spring in position, and approximately regulate the watch.

It would be both tedious and unprofitable to attempt to pass in review the various stages through which a watch passes; but as the kindness of several manufacturers, both English and foreign, has supplied me with a number of movements, &c., mainly with a view to show the extent to which machinery is employed in their production on different systems, I think we may with advantage devote some time to their consideration and comparison. But we shall be more in a position to do so after the three systems of manufacture mentioned above have been passed in review.

Now, the high-class English watch furnishes a sufficient proof that splendid work can be produced under the first-named system, and it may be doubted whether, for such work, any better could be devised; for many of the operations seem to be exceedingly trivial, and it is improbable that any single manufacturer should have so large a trade as to enable him to retain the services of so many specially skilled operatives. At the same time, it should be observed that this cannot be regarded as an economical system. Babbage, in his "Economy of Manufactures," lays it down that the division of labour cannot be successfully practised unless there exist a great demand for its produce, and, considering as we are at present doing only the high-class watch, there can hardly be said to be such a demand. But the system is strongly recommended by the fact that it enables a number of manufacturers to avail themselves of the most highly trained workmen, when these are remarkably few in number, and would not otherwise obtain sufficient employment.

While other points must take precedence of economy in the case of high-class work, it is of primary importance with regard to cheaper watches. Foreign watches of good quality are now sold in this country at such low rates, that an English-made watch, if of medium quality, must be sold at a moderate price also, or it will most assuredly, in time, be driven out of the home market, as it has already been to a great extent from abroad. The minutest economies must, then, be practised at every stage of its manufacture, and all parts that are not essential to fair time-keeping must be avoided.

I feel considerable diffidence in saying anyth[ing] on this question, as it is so essentially one [for] practical watchmakers, but I will briefly [allude] to one or two points for which the public [is in] a great measure responsible. If the buyers [of] watches—who, unfortunately, too often [know] nothing whatever of their internal arrange[-]ments—would content themselves with the [selec-]tion of a suitable case, leaving it to [the] watchmaker to decide on the nature of [the] movement, a great step would be gained. [But] as long as there is a demand for cheap watches provided with fusee, compensation balance, [full] plate, and the like, such watches will be made. The general introduction of keyless work has do[ne] much to prejudice the ordinary English trade, [for] its very manifest advantages have gone far [to] override the popular notion in favour of wind[ing] to the left, a feature by which the least initi[ated] could distinguish our own from foreign move[-]ments. Indeed, so deep-rooted is this distinct[ion] in some districts, that the introduction of Eng[lish] going-barrel watches has been much impeded, [and] certain manufacturers have been induced to [meet] it by providing a separate axis for the wind[ing] square, which carries a steel wheel engaging [with] a similar wheel on the barrel arbor; the wind[ing] is thus to the left, and the absence of a fus[ee is] not noticed.

This is only one example of the way in w[hich] prejudice interferes with the advance of the [trade.] But it is perhaps the most important, as it inv[olves] the question whether the fusee shall or shall [not] be retained by English watchmakers. If the [pre-]judice were done away with, the fusee coul[d be] regarded from the single point of view of [its] merits and defects, and it need not, as is at pre[sent] the case, be retained partly as a questio[n of] policy. In the last lecture I endeavoured [to] explain what are the real advantages of [this] system, and why it should form a part in high-class compensated and adjusted watch[es.] properly made, with a chain of sufficient thick[ness,] it need not be a source of weakness, but frequent breaking of chains, and the compa[rative] difficulty of its repair by ordinary workmen [has] done much to bring it into disrepute for ch[eap] watches. And, after all, is its retention [to be] desired in them? We have seen that its pri[ncipal] virtue consists in facilitating the adjustme[nt for] isochronism and positions. But it cannot be [said] that such watches as are here referred t[o]

or position and isochronism, and experi-
›s that they may be made to keep very
time from day to day, if wound up
without any such adjustment, as well
›od going-barrel as with a fusee and
this we have abundant evidence in the
of very many cheap French, Swiss, and
as well as in English going-barrel watches.
type of construction, moreover, lends
h more to the application of machinery
ıufacture, involves less risk of breakage
ge by careless workmen, and can be
keyless work at far less expense. There
en to be no real reason for the reten-
fusee in the class of watch we are con-
nd I believe that, if it were not for the
just referred to, manufacturers would
ady and willing to abandon it.

›nd system of manufacture referred to
system, namely, of collecting workmen
llied trades in one large factory, which
a position to produce finished watches
ough metal, has reached its most com-
lopment in America. There are many
ı the Continent and in this country, but
merica are on by far the largest scale;
›y are, I believe, the only makers that
anufacture *every* part of a watch on the
And it will at once be evident that only
producers could afford to do so, as many
though involving special skill, can be
great rapidity, and thus workmen en-
hem would be kept idle, unless a pro-
y increased number were engaged on
operations.

tham Watch Factory gives employment
)0 operatives, half of each sex, and pro-
t 100 finished watches a day, so that it
perience the difficulty above referred to.
1 distinct departments, and every branch
ıcluding, for example, hand, mainspring,
making is stated to be executed on the
Machinery is used to a very great extent,
ng a high degree of uniformity in the
les greatly increasing the speed of pro-
And this brings me to the main charac-
nodern watchmaking; the employment
-tools and steam-power.

t once say a few words as to the meaning of
ion "machine-made watch," as I believe
ly understood, even by all watchmakers.
in a sense, every watch would answer to
ription, as tools and machines of various
mployed in its construction. But the
eferred to are generally of a more elabo-
ter, and driven by power. They are,
of somewhat heavy construction, and
distinguishing feature is that, while
is made to facilitate their management,
of repeating indefinitely a given opera-
the utmost attainable accuracy, and
lled supervision, is regarded as of primary
. But this feature, the uniformity,
y easily made too prominent. It is
ble to produce the plates, bars, cocks,
d even the wheels and pinions, so that
or all practical purposes, interchange-
hen we come to the pivots, jewel-holes,
rious parts of the escapement, they are
he same sense, and it seems too much to
expect that machinery will ever make them so. I do not deny that it might be possible to replace any parts of one watch by the corresponding parts of another similar watch, but the chance of its keeping equally good time without further adjustment is small. Two pivots turned of the same thickness may require different degrees of polishing, and, therefore, their final diameters will differ. The accurate performance of an escapement depends on such a variety of conditions, that, although it may doubtless act when placed in a watch to which it does not belong, it cannot be expected to secure an equal rate without special adjustment.

I am aware that there is a considerable amount of opposition on the part of many watchmakers accustomed to the older system to the employment of machine-tools, but I venture to think that part of this is owing to a want of knowledge as to what may be legitimately expected of them, and part is probably due to the extravagant language too often employed in reference to this question. If our young watchmakers were brought up to be less exclusively watchmakers; if before making, say, an escapement, they could be induced to devote some of their time to a study of the tools they do use and might use, as well as to the actual making of such tools, there would, I feel convinced, be a natural tendency towards the principle of machine-tools. An ordinary pair of clockmaker's turns would, in the hands of an intelligent workman, lend itself to the construction of many devices for facilitating his daily work, and would often enable him to leave much of the work that now requires his personal supervision to a boy. Naturally, very little is known by watchmakers of the tools used in factories, but the kindness of many manufacturers, in London, Coventry, Prescot, and Birmingham, has enabled me to examine the machinery now in use, and I can most emphatically say that much of it will compare favourably with the watch itself in regard to accuracy of adjustment and beauty of finish. Tool-making is obviously of the first importance in a modern watch factory; and in Messrs. Rotheram's works at Coventry, I was much struck with a series of shops devoted specially to this branch, which appear to be provided with every available appliance for securing the most perfect workmanship in the machines they employ for watchmaking.

The history of the application of machinery to the watch manufacture has yet to be written. It appears that credit for its first suggestion cannot fairly be claimed by any one single inventor. Early in the present century, a number of manufacturers introduced it for special operations; and in 1839, Leschot established a machine-work movement factory in Geneva, which now belongs to the firm of Vacheron and Constantin. But P. F. Ingold, also a Swiss, appears to have first elaborated a series of both case and movement machines, their main feature being the production of any number of identical parts of a watch.

If we may credit the description given by Jurgensen of a machine designed by Ingold for making plates, they must have been extraordinarily complex. It was capable, he says, of producing a finished plate, polished, all the holes tapped for screws, steady-pin holes, including those for the escapement, with all the holes for the jewel

settings ready, sinks cut in the plate and polished both at the sides and bottom. His collection also included machines for making barrels, various parts of the escapement, together with balances, wheels, screws, and he had complete working drawings for watch-case machinery.

Ingold endeavoured unsuccessfully to establish a watch factory both here and on the Continent, and seems to have gone to the United States, about 1845, with the same object in view, but returned to Europe without having accomplished it.

In the report of the United States Commission on the Philadelphia Exhibition of 1876, group xxv., p. 90, it is stated that "In 1848, Mr. Dennison suggested to Mr. Howard the project of attempting the manufacture of watches by machinery, and two years afterwards, in company with Samuel Curtis, also of Boston, they established at Roxbury, Massachusetts, a factory of this kind. . . . . ." The reporter mentions these facts as evidence that his countrymen "first conceived the project to manufacture watches by machinery" (p. 89). But the machinery can only have been applied to a few branches of the art, for it is inconceivable that two years after the project was "suggested," they could otherwise have "commenced the manufacture of watches." Anyone who has seen the extraordinary variety of machines that go to produce a "machine-made watch," must admit that, even in the present day of rapid production, and with all the designs ready to hand, two years would be a very brief interval in which to establish such a factory. And at the above date, 1848, several factories were already employing machines in Switzerland, more especially at Geneva. The credit, therefore, of having first applied machine-tools to the manufacture of watches must be given to the Swiss.

In saying thus much in regard to the earlier applications of machinery, I would, of course, not be understood to deny that very much has been done in America to bring the system to a high degree of perfection. It was there that a sufficient amount of capital was first embarked in the undertaking to render a trial to the fullest extent possible. The well-known inventiveness of the American people has largely extended the use of machines, and they have done much to prove their applicability to watchmaking.

It is not, however, my present purpose to enter even briefly on the history of this question. I wish rather to show how far tools are used at the present day in the production of both English and foreign watches. A mere verbal explanation, besides being dry and uninteresting, would fail to convince, but I am fortunate in possessing a number of specimens of machine work for exhibition here this evening. And I would take this opportunity of expressing my sincere thanks to various firms who have so readily responded to my request by sending samples of their work, which in many cases must have been got together with no little trouble. The firms to which I am thus indebted are given alphabetically in the following list, together with the nature of the objects lent:—

Mr. Ehrhardt, Birmingham — Frames, with pivot-holes drilled.

The English Watch Co., Birmingham—Keyless watches, and their several parts in all stages of manufacture mounted on cards.

Messrs. Guye, London—Keyless wat[illegible] machine-made escapements, steel work [illegible] pivots, &c.

Mr. Hewitt, Prescot, Lancashire—M[illegible] full, ½-plate and ¾-plate, keyless, with [illegible] steel work.

Messrs. Japy Frère, Beaucourt—Rough [illegible] ment (*ebache*), with train.

Mr. Mercer, Clerkenwell—Stages of manufac[illegible] by hand, of marine chronometer detent.

Messrs. Patek, Philippe & Cie., Geneva—Key[illegible] movements, separate keyless mechanism and [illegible] work.

Messrs. Rotheram, Coventry—Machine-[illegible] pinions, pivots, wheels, and wheel-blanks.

Mr. Taylor, Prescot—Chronometer wheels [illegible] pinions.

Mr. Tripplin, London — Details of fini[illegible] Besançon watch.

The Waltham Watch Company, Mass.—Det[illegible] finished Waltham watch, with additional pieces [illegible] show pivoting, &c.

Mr. Wycherley, Prescot—Machine-made [illegible] fusee movement; also detached pieces to [illegible] stages of manufacture from rough metal.

I propose to exhibit a selection from [illegible] specimens in the lantern, but would at [illegible] mention that the series lent me by the Eng[illegible] Watch Company is very complete. It compri[illegible] very great variety of pieces mounted on 13 ca[illegible] which may be regarded as typical of the [illegible] operations in watchmaking to which machinery [illegible] applied at the present day. I am not aware [illegible] so complete a series has been previously exhib[illegible] in this country, and cannot but feel that the [illegible] lection is worthy of very careful study. [illegible] machinery can be arranged to produce some of [illegible] elaborate pieces shown on these cards, it can [illegible] almost anything; and, whatever we may say [illegible] interchangeability, there is no doubt that the [illegible] will require a far less amount of fitting than [illegible] do on the hand system. It would be impo[illegible] for me to even enumerate the pieces that are [illegible] exhibited, and I will only draw your attentio[illegible] one very marked feature, the immense amou[illegible] labour that is saved by the use of the pun[illegible] machine. There are very few pieces in either [illegible] watch or case that do not in the first ins[illegible] pass through this machine, and the amou[illegible] filing avoided must be immense.

It is difficult to form an exact estimate of [illegible] average number of machines employed in [illegible] manufacture of a watch. They will, in g[illegible] measure, depend on the amount of produ[illegible] since, of course, as this increases the tools will [illegible] more specialised. Mr. Gooding, of Mess[illegible] Rotheram's, at Coventry, tells me that the nu[illegible] required for the movement, exclusive, that is, [illegible] the case, dial, hands, spring, and balance, [illegible] be taken at about 100, which is made up [illegible] follows:—

	Machines
Plate making	12
Wheel and pinion	36
Steel work	12
Escapement	23
Jewelling	11
Screws	6
Total	[illegible]

And he estimates the time occupied in making [illegible]

hinery at 30 hours, about half that ie hand system.
ins the third system of manufacture which is merely a combination of the erred to. It is the most generally ll, but evidently will include very anised establishments distinguished the extent to which machine-tools in the manufacture. The English present day, as compared with that of years ago, before movement making shed by means of machines, would ito this class. But what I rather nclude is the watch factory as we in this country, one that builds up timekeeper, but does not necessarily ch special work as cases, dials, gs, mainsprings, balances, &c., or even Several of the English firms to whom for assistance this evening would thus nd others exist. It cannot be doubted establishment can turn out work of quality at moderate cost, and it advantage, that it may be of any gnitude; the larger factory only n the smaller in that it comprises nches of the trade, generally involving , which, if undertaken, might tend to cost of production. Thus, take the il-setting. In one factory that I ewellers were able to do all the work. therefore, that when less than half f watches is made in the same time, not be constant employment for even and it might be more economical work done elsewhere. At the same be presumed that the number of which this holds good will gradually a limit is reached, as the employment extends, for it will only involve nding idle for a definite period; or the r very general, of adapting a single veral purposes would be applicable.
said enough with regard to the system and will proceed to consider the the table. At the outset one feature the types of watch, with the exception he Prescot movements, have going-hese movements that form the exception for completion on the hand system ined. It is evident that the going tself to machine work far more readily e, and one cannot but feel that an im-n for the opposition to the latter is n this fact. Enough has, however, . said on this subject, and I would at, admitting the applicability of the manufacture of watches, this is nk as a sound argument against the se in ordinary watches.
number of specimens illustrating the s of manufacture of watches, both on and hand system, were here exhibited . They included many stages in the of the movement as practised in gh movements from Birmingham, Geneva, and London, as well as ement and parts of watches lent by rms to whom reference has already been). The images were obtained by direct reflection of the beam from an electric lamp, thrown on the surface of the object. The light being incident at very small angle, an image was obtained, very slightly distorted and in natural colours.]

The examination of these specimens, even in the very inefficient mode I have been compelled to adopt, must suffice to convince an unprejudiced observer that, at any rate for watches of ordinary quality, machinery can be extensively employed with marked advantage. It secures a greater degree of uniformity in the work, a more rapid production, and may reasonably be expected to reduce the cost of the watch. How far its use is desirable in the highest branches of the art is a question for practical horologists to discuss. In the best English watches uniformity is not of the same importance, and minute economies need not be so carefully practised. Indeed, the present system is well adapted to their production, as is sufficiently proved by the fact that foreign makers have not succeeded in underselling us in this particular grade. Each instrument receives an amount of individual attention that would almost involve a direct contradiction of the main principle on which the application of machinery is advocated—a principle which is often expressed by that unfortunate word, interchangeability.

But the subject must be looked at from a very different point of view when we come to consider the cheaper class of watch; the branch of the trade in which so keen a competition is going on at the present day. Admitting that such a trade is worth preserving, and the statistics already given prove indisputably that it is, the question as to how it may best be fostered becomes a very urgent one, and I would make a few observations bearing upon it. At the outset, however, let me earnestly disclaim any desire to dictate to the trade; watchmakers know the details of their own business best, but what I do wish is to bring the matter more prominently forward, and to urge a more thorough discussion than has yet taken place, as to the reforms that can, with advantage, be introduced into the art, and the points in which we can take advice from our neighbours.

The general depression of trade cannot be held to be solely or even chiefly responsible for the present state of things. Within the last 30 years two new watch-producing countries have practically come into existence. France, although of course the trade has long been established there, has within that period increased its production ten-fold, and in America we have a new competitor. I have already pointed out that, judging from the official returns, we actually export from this country about the same number of foreign watches as of those of home production, whereas the imports for home consumption reach a total of about 250,000, or more than six times the total exports of home and foreign make.

At the risk of being considered a prophet of evil, I venture to refer to the state of the clock trade in this country as bearing on the subject we are considering. Fifty years ago we had a trade in clocks, and no one could have anticipated that, at the present day, it would be practically dead, the only exceptions being turret, regulator, and a few chime clocks, the value of the exports of which amounts to about £50,000. The Continent and America have taken possession of the entire

trade in ordinary timepieces; and in his official report on the 1878 Exhibition at Paris, M. Saunier mentions a fact in relation to it that is well worthy of note. While the production of the higher quality of clocks shows a tendency to fall off, or, at most, to remain stationary, the number of cheap clocks is increasing at a very rapid rate. Whether the same is to be said of watches we have no sufficient means of ascertaining, although the gradual fall in the mean price of English clocks and watches during the years 1867 to 1870, the last for which we have the requisite data, seems to point to some such conclusion; at any rate, it is not safe to hazard a guess as to whether such a tendency would continue: the mere possibility of it, however, indicates the necessity for our doing our utmost to preserve the watch trade intact, and not, as some would advocate, to surrender the cheaper trade without a struggle. At the same time, it is well to observe that there seems good reason to hope for an improvement in the average quality of watches in the future, independently of any advance in the horological art. As the habit of wearing a watch becomes more universal, the desire to possess one of superior quality may be expected to spread in even greater proportion, and the well-known tendency of modern life to make more and more use of our time, necessarily involves greater care in its accurate admeasurement.

I do not pretend to be able to explain the causes which have led to the destruction, more or less complete, of many branches of the horologist's art in this country, but would earnestly commend to all interested in it, the suggestive and most important address, devoted mainly to the subject of foreign competition, which was delivered by the Chairman of the Council of this Society, at the opening of the present Session. We may be sure that Mr. Bramwell had not watchmaking specially in his mind when writing that address; and yet there are many passages in it that might have been intended to have reference to this art. He says:—*

"We shall find, it may be, that many of our industries are carried on according to the old traditions, traditions of practices which were the best known in the days when they were first employed, but which, under the teaching of science in other countries, have been abandoned as obsolete while they are retained by ourselves. We may find, paradoxical as it appears, that the fact of our having been engaged in any particular manufacture for many years obstructs our readily adopting the most improved form of carrying on that manufacture."

And there is one other passage in this address which I cannot refrain from quoting. Speaking of the field of work open to the Society of Arts, the Chairman says:—

"Why should it not put itself in communication with the manufacturers in some industry which is suffering its hold on foreign markets and, it may be, even its hold upon the home market, to be interfered with by the foreigner, to ascertain from these manufacturers whether the competition against them is succeeding on the score of price, or on that of quality, or on the score of the higher knowledge possessed, or the better taste displayed abroad. If it be on account of price, let us find out whether the disparity arises principally from the labour question, or whether it arises, as it in countries where labour is dearer than in o the use of improved processes in those countri cesses which we have failed to employ . . . have sufficient confidence in the skill and abilit the amount of capital available in this country, i it needs only that the true causes of the succes competitors should be discovered, to make us eff bestir ourselves to restore the threatened indust former safe position."

Would not watchmakers have real caus grateful if this Society would make their subject of investigation as suggested in the graph I have just read?

In another part of the same address the of Technical Education are brought promi forward, and I am sure that no one will pared to doubt that horology ranks high those industrial arts that involve the applic science for ensuring any real advance. refer to this subject in the next lecture, an here only mention that it is one of the 32 which examinations are annually held by and Guilds of London Institute for the A ment of Technical Education.

It is highly improbable that a liber machine-tools should not tend to amelic trade, when there is hardly another trade not received invaluable help from them watchmaker can tell for himself, either by ing a movement or such samples as I h what degree of assistance it has afford Americans, a people that, prior to about no experience of the subject; how much should it help us, when we have been pr as watchmakers for centuries.

When Arkwright patented his "spinnin there was a very great outcry against it, a ing the manual skill of the workmen; bu objection can legitimately be made in thi I have already been careful to point out, watchmaking exists, it will be impossi without a considerable amount of skilled the adjustments, and this would be the in the commonest of watches. I an that there should be no doubt whatev point, and the most striking example I able to adduce consists in a comparison the prices of two watches manufac machinery in America, where, as is gen mitted, its use has been pushed as far as They are movements of the same size; th approximately adjusted for heat and c about £12, and the other, more highly fin adjusted, is quoted at nearly £50, more times the price of the first, and yet, to an observer, such difference as there is wo comparatively little moment. One m assume then that at least half of the the higher class watch has been on sk skilled labour. Thus we have no pre to complain that any system has prov to be superior to that adopted in this so far as regards the best work, a is now principally needed is that the of competent workmen should be su Machine work need not, then, degrade the skill of our artisans, and the fear tha necessarily cause the English watch to less artistic than at present is equally un

* *Journal of the Society of Arts*, vol. xxix (Nov. 19, 1880), p. 10.

at a particular machine does not pro- c work is, of itself, no evidence against being able to do so, and there are specimens on the table to show that rms can be secured by such means. in the cheapest watch, what is wanted ss and good timekeeping, and, if need- labour might be relied on for modifying according to taste in the higher grades. pid growth of the production of foreign as compared with our own, if it means must be taken as evidence that the English manufacture is not adapted to the cheaper tch. If it were, it would be simply im- hat more than a quarter of a million of de watches should be annually required he demands of the home market.

rs, then, to be a peculiarly convenient e a new departure, and if several of the inent manufacturers could be induced to take the matter into their considera- ining how best to systematise the trade, example from our competitors, and if n would lay to heart the lesson which s I have been able to collect teach him, ible but that much good would result. ous learned societies, the engineering rofessions, keep themselves abreast with s made, both at home and abroad, by eir journals and their periodical meet- he horologists of this country, although a monthly journal and a newly-erected ust, I think, admit that, as a body, not hitherto taken sufficient practical ither.

ry far from denying that many horo- keenly alive to the necessity of im- e system so that it shall be more in with the requirements of the present eir efforts have hitherto failed, owing fference with which every suggestion . Their journal and their institute unquestionably good work, as a means on, and in keeping those engaged in the r, by affording them a means of inter- tion; but a far higher work remains to hand by them, namely, the placing of English trade on a satisfactory footing. marks, although provoked by a con- f the state of the trade in the cheaper atch, cannot but be more or less to the case of higher qualities. At the no mechanical art can afford to stand although the best English watch has its position, even that position is being assailed from several quarters, and it inue to be held without some effort.

be evident from the specimens of rk on the table, we already possess l several factories more or less com- d up with machines for the manu- watches on the modern system. But ce of the several establishments to ence has been made does not disprove nglish system of watchmaking is the n, and the problem that now urgently lution is how best to benefit those the manufacture, and, at the same omote the trade of the country. All f temporary depression of trade may be laid aside in discussing such a question, for it is a well-known and acknowledged fact, that even in times of commercial prosperity, the trade, taken as a whole, is in an unsatisfactory condition. For years past the cheaper watches sold in this country have been mainly of Swiss and French make, and America is now coming in for a share of the market. And here it may be well to observe that the English makers seem to be unwise in thus neglect- ing the cheap trade. Preach as you will about the comparative advantages of an English watch, if foreign makers can afford to sell a watch that is a fairly good timekeeper, and often more graceful than that made here for about twice the amount, there can be no wonder if it is in very many cases preferred. The fashion of wearing watches is gradually spreading through lower and lower grades of society, and if the home makers cannot or will not supply this demand, they have no right to complain of other countries taking the matter in hand. And it is unreasonable to suppose that we can hope to permanently retain the higher branches and so consistently neglect the lower. The entire trade is so small in extent that neither portion can afford to dispense with the other; indeed, the lower is, perhaps, of more service to the higher than the higher is to the lower, for, as it becomes more and more general to carry a watch, the inducement to those able to afford one of high quality to become possessed of one is greater; and only those who have tried the experiment know what a real satisfaction there is in being provided with a thoroughly reliable timekeeper.

How then are the interests of this beautiful in- dustry to be best promoted? I do not pretend to be able to answer this question, but there are a few points to which, with your permission, I should wish to draw attention, in the hope that the sub- ject may be earnestly taken up by others. In the first place, it must be admitted that the English system is not calculated to encourage radical im- provements. Each workman through whose hands the watch passes is, as a rule, acquainted with only a small proportion of its details, and thus, through being unable to take a general view of the question, is placed in an unfavourable position as an in- ventor. The watch-jobber, into whose hands the watch comes for repair, stands a better chance of detecting faults of construction, and suggesting a remedy.

The extraordinary amount of independence to which the system has given rise, causes much need- less expense and waste of time in the production of a watch. A number of trifling faults are often allowed to accumulate in the watch, each work- man apparently leaving a legacy for his successor to correct. Thus it happens that some are sure to be left uncorrected, except in the very best work, and they secure the watch a bad name, if not at once, at any rate after a short time. Of course, on any method of manufacture there would be a risk of some such sources of error, and I am not pretending that these objections are peculiar to the English system. But a discussion lately held at the Horological Institute, at the instance of Mr. Bickley,* seems to show that our system, with careful management, is capable of vast im- provement: it is inconceivable that at the present

* *Horological Journal*, xxii., 27.

day so much double work as is done on an English watch is unavoidable.

And one obvious mode of avoiding it, at all events in great part, is the employment of exact machinery to the utmost extent. The most earnest advocate of the hand system cannot but admit that it is responsible for by far the greater number of these irregularities. A man, after making several hundred similar objects, such as screws, may, doubtless, arrive at making them alike by the sole aid of his sight and touch; but this is not true where only a few dozen specimens are made at a time, and they of a more complex form.

But how to popularise the use of machinery is a very difficult question. The factory system would certainly not be welcomed in Clerkenwell. And it may well be doubted whether its introduction would be advisable; the English system has so long consisted in a certain degree of isolation of various branches that efforts should rather be directed towards the improvement of this system, and the setting of it on a more satisfactory footing. Let Prescot retain the movement-making, Coventry the case-making, in addition to its own individual trade of watch-making, Clerkenwell the finishing, escapement-making, &c., but if the trade is to continue a trade, these several branches must work more into each other's hands. It is absurd that one man should systematically be called upon to undo the work of his predecessor, when by proper organisation all such contradiction might easily be avoided. In a watch factory each man, of course, works to a template, and it is surprising that there should be any occasion to advocate its use at the present day, in any of the mechanical arts that involve the production of a number of identical pieces. It is difficult to see why a common standard should not be introduced in the watch trade, and its adoption would constitute a very important step in adapting the English system of manufacture to modern requirements.

We have already seen, from an examination of Prescot movements, how far machinery is employed in what has been termed the "hand system," practised in this country. It is hardly open to question that its use might be extended with very great advantage; and if an accurate system of gauges and standards existed, might not the movement maker carry on the work to a certain definite point, and then hand it over to the Clerkenwell workmen, who would take it up where Prescot left off, without having to do over again any portion of what has already been done well. But it need not necessarily follow that the use of machinery would be confined to the movement-maker.

A principal feature of this system, which stands in the way of any material change, is the great number of small establishments that have to be kept up in Clerkenwell. They not only occasion delay, increase the cost, impede the introduction of improvements, and cramp the abilities of individuals, but they are, in too many cases, utterly unfit for occupation, and cannot fail to have a most detrimental influence on the character of the workman as well as on both the quantity and the quality of his work.

A suggestion recently made by Mr. Glasgow at a meeting of the Horological Institute is worth careful consideration as bearing on this question. Would it not be practicable to establish in [Clerk]enwell, one or more large shops, where work[men of] all the branches of the trade could rent suc[h space] as they required? How many advantage[s might] be secured by some such arrangement? [It] would not only secure a healthy place of b[usiness] specially adapted to their several requir[ements] and away from their homes, but would [bring them] brought more in contact with each other [and the] trade generally. But I venture to think t[hat the] scheme might enable them to secure anoth[er and,] in some respects, a yet more important adv[antage;] it would immensely facilitate the introduc[tion of] modern improvements, both in the watch [itself] and in the tools employed in its prod[uction.] Steam power might also be let to the tenan[ts, and] there can be little doubt that the possessi[on of it] would act as a powerful incentive to the [use of] tools wherever desirable. Working to th[e sys]tematic gauges above referred to, the mov[ement] might thus be taken in hand as receiv[ed from] Prescot, and pass through the several stag[es that] go to make up the Clerkenwell branch of th[e trade.]

I could not pretend, even if this were a [fit] occasion, to follow out the above suggesti[on in] all its details. It is essentially a questi[on for] practical watchmakers, and if this or any [other] scheme, having similar objects in view, hav[e their] cordial support, much will have been done t[o show] that we are, to again quote the words [of Sir F.] Bramwell, "effectually bestirring oursel[ves to] restore the threatened industry to its form[er] position."

MISCELLANEOUS.

LONDON FISH SUPPLY.

The following statistics relating to the s[upply of] fish brought into London by the various railw[ay com]panies, have been elicited by the inquiry inst[ituted by] the Corporation of London, and now being c[onducted] in the Upper Court, Guildhall.

Mr. W. Birt, general manager of the Great [Eastern] Railway Company, said his company carrie[d ...] tons of fish to Billingsgate last year from vari[ous parts] of the east and north-east coast. Prime fish a[t owner's] risk, was carried at 32s. 6d. per ton, and off[al at] 21s. 8d. per ton, from station to station. The[se rates] included the market dues, but not the deliver[y, which,] if performed by the company, was charged 5s. [per ton] extra. It was at the option of the senders [whether] they sent at their own or the company's risk, [but] as a fact about 95 per cent. was sent at own[er's risk.] The company's risk was 6s. 8d. per ton for pri[me,] and 3s. 4d. per ton for offal. The difficulties at [Billings]gate were very great. A return was made o[n a day] this year, when it was found that upon an aver[age each] van was delayed four hours at the market. [In the] experience of his company it appeared to th[em that] two or three markets were needed in London [to meet] the demands of the fish business of the pres[ent day,] rather than one central market, and so impres[sed were] they with the necessity of such a change, that [they laid] out the large works to be constructed at Bish[opsgate;] they had set aside about two and quarter acre[s of land] to be used as a fish market for railway-bo[rne fish.] Such a market would save the 5s. now cha[rged for] cartage. His company not only proposed to e[rect] the market, but to erect nine warehouses in w[hich]

le could be carried on. Should an improvement be le in the fish market of London with greater facilities unloading, and should the supply of fish increase, had no doubt that his company would reduce their s.

Mr. J. Noble, general manager of the Midland Rail-y, said his company carried 9,280 tons of fish to don in 1880. Haddocks and plaice from Hull and msby were charged 35s. per ton; that did not in- delivery. Some fish was sent by passenger train, the extra cost of that was from 6s. to 9s. per ton, ding to the kind of fish. The delivery of tanks of nvolved an extra charge of 10s. for cartage. Re-g to questions, the witness said his company had a ity of land at their disposal at St. Pancras, and he thought of allocating a portion of it as a fish t. He was in favour of a large central market of access.

H. Oakley, general manager of the Great hern Railway Company, said his company con- 26,543 tons of fish to Billingsgate last year. rates varied from 30s. to 70s. for coarse fish from nd. The average rate for prime fish was 46s. 8d. Hull and Grimsby. The greatest difficulty was rienced near Billingsgate in getting vans up to the et. They allowed three hours and a-half for their to deliver the fish at the market, but, as a rule, it pied between six and seven hours, and sometimes hours. In fact, it took as long for a van to go from 's-cross, deliver the fish, and return, as it did to y the fish by train 200 miles through the country. rates he had quoted did not include delivery, for h a charge of 5s. was made. A central market streets running through it, and easy of access, d be very desirable in the interest of both buyer seller.

r. D. Stevenson, traffic superintendent of the lon and North-Western Railway, said that about tons of fish were conveyed by his company to ngsgate last year. The rate from Scotland was per ton by passenger train and 55s. per ton by s train. For goods by passenger trains an extra e of from 4s. to 5s. was made. To make Billings- large enough, it would be necessary to throw into uncovered land of the Custom House on the one and on the other the land covered by Nicholson's f, up as far as London-bridge. He thought there t be two markets, one for water and the other for ray borne fish. The charge for the carriage of fish three or four times as much as was paid for iron. from Liverpool was charged 25s. per ton, while om Holyhead was 55s.; that was on account of k attached to the carrying of fish.

H. Lambert, chief goods manager of the Great ern Railway, said that his company conveyed tons of fish to Billingsgate last year. The cost of eyance from the West of England was 60s. per ton, from New Milford 65s. 6d. All fish trains ran at speed, and the company undertook to supply a al train within three hours whenever the senders a supply of 20 tons weight. Although quickly ht to London, it often took from four to eight s to get it delivered at the market. He did not e the present market, however much improved, be made a suitable market for all London.

Mortimer Harris, manager of the London, ham, and Dover Railway, said that his company eyed 2,530 tons of fish to Billingsgate in 1880, for h they charged a rate of 22s. per ton for coarse fish, 40s. for other sorts. He was favourable to the lishment of several markets in the metropolis near the railway termini.

Mr. J. Light, goods manager of the South-Eastern way Company, said that 3,071 tons of fish were ed by his company last year. The rates from ings were, for prime fish, 40s. per ton; and 22s. for coarse fish.

Mr. Arthur Johnson, fish meter, was examined, and said that his duty was to inspect all the fish as it came on the vans, and also by boat, into the market. The quantity which was received could not be given accurately, as it varied each month. Sometimes 500 tons would arrive, other days 830 tons would be received. The average quantity sent to Thames-street, Billingsgate, and into the market, was 1,700 tons per month altogether. During the last six months, from the 1st of January to the 30th of June, the quantity condemned was forty tons per month, of which one-third was shell fish and the other wet fish, such as plaice and haddocks. If the market had been ten times the size it was, it would have made no difference, as a large quantity of the fish so condemned was seized in the railway vans. The delay in the vans could not be helped. The fish was condemned chiefly between six and seven in the morning, when it came into the street. The bulk of the fish was condemned on the Monday, which was on account of its being delayed on the Sunday. That would happen in any market. He was of opinion that the fish condemned on Monday was bad before it left the railway station. They threw the condemned fish into tanks filled with acid. While this condemned fish was being unloaded the space in the street was being taken up, and prevented the business going on until it was cleared away. He was authorised by the Fishmongers' Company to seize fish on his own responsibility. It was not always necessary to call in another inspector before condemnation. The quantity of fish coming by water varied very much.

This subject of fish supply is one in which the Society of Arts has always exhibited the greatest interest. As early as 1761 the Society advanced the sum of two thousand pounds to Mr. John Blake, for the purpose of carrying out his scheme for the supply of the markets of London and Westminster from distant sea ports and rivers by land carriage. During the last few years the subject has been considered by the Food Committee.

PANAMA CANAL.

A correspondent of the *Journal des Débats*, writing from Panama, gives an account of the progress made thus far with M. de Lesseps' great undertaking. The first practical work of any importance yet completed, is the construction of a grand pathway from Colon to Panama, which has been cleared of trees and other obstructions to a width varying from 30 to 60 feet. Now that this clearance has been effected, it is possible for the first time to get a clear idea of the work which is before the company. Hitherto, it has been only by rather vague guesses that the lie of the surface could be conjectured, inasmuch as the thick foilage of the trees, spreading over the valleys and ravines, often made it difficult even to see that these existed. If it was assumed, as the *Débats* thinks, that in these cases the ground was as flat as the tops of the trees, then the discovery of deep depressions so arched over will be a great gain in estimating the extent of the excavation works. There is, however, another point in which the most recent explorations are regarded as unexpectedly favourable. It was assumed when the plans were made that all along the route of the projected canal a stratum of hard rock would be found underlying the soil at a depth of about twelve feet. But at Emperador, where the principal borings have been made, it is stated that on March 31 the instrument had reached a depth of 37 feet without finding any rock, and even at that point the rock which appeared was only a layer about six feet thick, succeeded underneath by a mixture of clay and soft stone, which went down to a depth of 64 feet, where the bore was still working lately without encountering any rock. It is now said that the excavation works will be begun about October next, after the rainy season, and in the meantime the preparatory

operations are being actively carried on by companies of workmen, recruited from amongst the inhabitants and from Carthagena, whence they have been driven by an invasion of locusts.

NOTES ON BOOKS.

Suggestions in Design, being a Comprehensive Series of Original Sketches in Various Styles of Ornament, arranged for application in the Decorative and Constructive Arts. By John Leighton, F.S.A.; with descriptive and historic letter-press by James K. Colling. London: Blackie and Son. 4to.

As long ago as 1852, Mr. Leighton published a work with the same title, under the *nom de plume* of Luke Limner, which contained the nucleus of the present book in the shape of 47 plates. The author has revised and re-drawn these, and added more than an equal number of fresh illustrations. The object is to present a large series of designs conceived in the spirit of a considerable variety of styles of art, which may be useful to artists. These plates "are intended as aids to design rather than for servile imitation or direct appropriation, serving to represent the type of many designs, and not the exact portraits of any. The object of the author, therefore, being to present suggestions, leaving the designer or art workman to modify or adapt them to his own purposes, it is hoped that the book will be found eminently suited to the wants of all engaged in decorative and ornamental work." The subjects are arranged in the following order:—First, those of general periods and nationalities—Savage tribes, Egyptian, Assyrian, Greek, Etruscan, Pompeian, Roman, Chinese, Japanese, Indian, Persian, Moorish, Byzantine, and Gothic. The Renaissance is seen in some of its various developments, then more special conceptions are shown in floral decorations, figures, chimeras, &c. Designs for metal work, inlaying, blazonry, &c., are also given. In the descriptive letterpress, the various points, as shown in the plates, are taken up *seriatim*, and the general principles of design have a special chapter devoted to their discussion.

A Practical Treatise on Coach-Building—Historical and Descriptive. By James W. Burgess. London: Crosby Lockwood and Co. 1881.

The author affirms that it is over fifty years since an exhaustive book on the trade of coach-building has been published, and he has, therefore, attempted in this hand-book to point out the general principles upon which carriages should be constructed. The first chapter is devoted to a general history of the subject, from the Egyptian war chariot to the carriages of to-day. The various parts of a carriage, the painting, the lining, &c., are treated of in subsequent chapters. In the general remarks on the trade, a hopeful view is taken of the increased skill and ingenuity of the coach workman, and the author alludes to the beneficial influence of the Exhibitions of the Coachmakers' Company.

The Diamonds, Coal, and Gold of India, their mode of Occurrence and Distribution. By V. Ball, M.A. London: Trübner and Co. 1881.

Mr. Ball designs his book as a hand-book to the detailed accounts of the more useful mineral deposits of India, published by the Geological Survey of India and other authorities, the results of which thorough explorations have not hitherto, he believes, been introduced into text-books. With regard to diamonds, he believes the Koh-i-nur to be identical with the Great Mogul diamond described by Tavernier, which came from Kollur. The author is of o[illegible] there is not the least ground for supposin[illegible] localities where mining is possible have been [illegible] and he thinks that if Europeans would [illegible] diamond mining in India, they would find it [illegible] Of the other two subjects treated of in thi[illegible] author gives an account of the various coa[illegible] tributed over the whole of India, and of [illegible] producing tracts, which consist of Wynaad [illegible] in Madras; Dharwar, Belgaum, and Kalad[illegible] bay; Central Provinces, Orissa, South-We[illegible] North-West Provinces, including Himal[illegible] Punjab; and Ultra-peninsular areas, such [illegible] Burmah, Afghanistan, and Thibet.

Sketches in Water Colors. By Vario[illegible] (Vere Foster's Drawing Books, Extend[illegible] London: Blackie and Son. Three parts, [illegible]

These sketches consist of chromo-lithograp[illegible] ings, by F. M. Richardson, R.P. Leitch, J. A[illegible] F. L. Rowbotham, E. Duncan, and J. Nee[illegible] full directions are given as to the way in [illegible] may best be copied by the learner.

Easy Studies in Water Color Painting. [illegible] Leitch and J. Callow. London: Blackie [illegible]

The nine chromo-lithographs here given [illegible] for the use of those students who have alrea[illegible] proficiency in pencil drawing, and wish [illegible] knowledge of the art of landscape paintin[illegible] colours.

GENERAL NOTES.

Institution of Mechanical Engineers.—[illegible] meeting of the institution will be held this y[illegible] castle-on-Tyne, from Tuesday, 2nd, to Friday, [illegible] There will be excursions on each day, and a lar[illegible] Works will be open for the inspection of me[illegible] Secretaries' office will be open on Monday, [illegible] Memorial Hall, Newcastle-upon-Tyne.

Technological Hand-books.—Messrs. Geo[illegible] Sons are preparing for publication a series of [illegible] Hand-books for the use of candidates in the [illegible] Examinations, which, instituted by the Socie[illegible] 1873, were, in 1879, transferred to the Cit[illegible] Institute. The rapid increase in the number [illegible] since the examination scheme was remodelled, [illegible] examinations have been supported by the fri[illegible] associated Guilds, is considered to justify the [illegible] that these hand-books will be successful, since i[illegible] there are many artisans and others who are seek[illegible] themselves familiar with the theory of their speci[illegible] It is intended by the publishers eventually to in[illegible] series all the industries specified in the progr[illegible] City Institute; but at first those branches of [illegible] have been selected for treatment in which it [illegible] text-books are most required. In accordance w[illegible] six books are now announced for publicatio[illegible] Bleaching, Dyeing, and Printing, by Willia[illegible] F.R.S., V.P.C.S.; "Iron and Steel Manufact[illegible] K. Huntington, F.C.S., F.I.C., Professor of M[illegible] King's-college, London; "Telegraphs and Tele[illegible] W. H. Preece, F.R.S., Memb. Inst. C.E., E[illegible] the General Post-office; "Cotton Manufactur[illegible] Spinning; Part II, Weaving; by R. Marsden, [illegible] *Textile Manufacturer.* "Glass Manufacture. [illegible] Sheet, and Plate Glass, by Henry Chance, M[illegible] Bros., Birmingham); Flint Glass, by H. P[illegible] (Whitefriars Glass Works); Optical and Light[illegible] by John Hopkinson, M.A., LL.D., F.R.S. T[illegible] issued under the general editorship of H. Tru[illegible] the Secretary to the Society of Arts.

. OF THE SOCIETY OF ARTS.

No. 1,498. VOL. XXIX.

IDAY, AUGUST 5, 1881.

…ons for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

[FURNITURE EXHIBITION.

…bition of Works of Art Applied to …in connection with the Exhibition of …t the Royal Albert Hall, is now open …on-transferable season ticket will be …member of the Society on application …tary.

…EDINGS OF THE SOCIETY.

…PATENT-LAW AMENDMENT.

…mittee appointed for the purpose by … have prepared a draft Bill, which has …ted to the Council and approved by

…lance with the instructions of the …s Bill is now published for the con… …f the members and of the public, as …rst draft of a Bill which, in the opinion …cil, embodies the essential provisions …hensive Patent-law.

…ncil will summon a public meeting in … for the discussion of the Bill, after …ures will be taken to obtain its intro… …Parliament, in the Session of 1882.

…wing is a list of the Committee by …Bill has been prepared:—Sir Frederick …F.R.S. (Chairman); F. A. Abel, C.B., …red Carpmael; Sir Henry Cole, K.C.B.; …uglas Galton, C.B., F.R.S.; W. H. …L.S.; C. W. Siemens, LL.D., F.R.S.; …man Wood (Secretary).

…etary will be glad to receive from … the Society and others any observa… …mments on the Bill which they may …send for the consideration of the Com…

…as been printed in the usual form, and …e had on application at the Society's …6d.

H. TRUEMAN WOOD, *Secretary.*

The following is the full text of the Bill:—

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FT OF A BILL TO CONSOLIDATE WITH AMEND-
ENTS THE LAW CONCERNING LETTERS PATENT
OR INVENTIONS, AND FOR OTHER PURPOSES.

hereas it is highly important, for the good he Arts Manufactures and Commerce of this m, that new and meritorious inventions should ive all possible assistance and encouragement;

nd whereas the existing law does not suffi-tly secure property in an invention to its true ntor, or offer him such encouragement as may ice him to develop his invention for the lic benefit, and is in other respects defective ill-calculated to promote the progress and of such inventions as aforesaid;

nd whereas it is therefore expedient that the concerning Letters Patent for Inventions be nded and consolidated;

e it enacted by the Queen's most Excellent esty by and with the advice and consent of Lords Spiritual and Temporal and Commons his present Parliament assembled and by the hority of the same as follows:

PART I.

Preliminary.

—(1.) This Act may be cited as the Patents Inventions Act 188 .

.) This Act extends to the Channel Islands to the Isle of Man.

.) This Act comes into operation (except where s otherwise expressed) on the *first* day of *uary* 188 , which time is herein referred to as commencement of this Act.

The Acts described in the First Schedule to Act are hereby repealed as from the commence-t of this Act to the extent in that Schedule tioned.

ll rules and regulations made under any of the tments repealed by this Act are also hereby aled as from the commencement of this Act.

In this Act—

"The Statute of Monopolies" means the Act of the twenty-first year of the reign of King James the First, chapter three, intituled An Act concerning Monopolies and Dispensations with Penal Laws and the Forfeiture thereof:

"Invention" means anything which may be the subject of the grant of a patent under this Act, and includes an alleged invention:

An invention is deemed new for the purposes of this Act if it has not been published or publicly used in the United Kingdom the Channel Islands or the Isle of Man, within the *thirty* years immediately preceding the date of the application for the patent for it:

"Patent" means letters patent for an invention:

"Applicant" means applicant for a patent:

"Patentee" means the grantee of a patent, and includes his executors administrators and assigns:

"Examiner" means an Examiner of Patents under this Act:

"Commissioner" means a Commissioner of Patents under this Act:

"Expert" means a person specially qualified by his knowledge of manufactures or science or arts to assist the Commissioners of Patents in the case in which his assistance is sought:

"Abroad" means out of the United Kingdom the Channel Islands and the Isle of Man:

"The Treasury" means the Commissioners of her Majesty's Treasury or two of them:

"The High Court of Justice" means her Majesty's High Court of Justice in England or Ireland, as the case may require:

"Prescribed" means prescribed by general rules made by the Commissioners of Patents under this Act:

For the purposes of this Act a year in relation to a patent is reckoned as beginning on the day, or the anniversary of the day, of its date, and ending at the end of the day next before the anniversary of the day of its date.

(i.)—*Exception from Statute of Monopolies.*

4. All patents duly granted under this Act are hereby excepted from the operation of the Statute of Monopolies, and shall not be invalidated or affected by anything therein contained.

(ii.)—*Subject Matter of Patents.*

5. A patent may be granted under this Act for—

(*a.*) Any manufacture or any product not being a natural product;

(*b.*) Any machine or any means of producing any manufacture product or result;

(*c.*) Any process or method of producing any manufacture product or result;

(*d.*) Any part of a machine means process or method of producing any manufacture product or result.

6.—(1.) A patent may be granted to any person, whether a British or foreign subject, declaring himself to be the inventor of an invention within the meaning of this Act, or to his executors administrators or assigns or to his or their attorney or agent, subject to the provision made by this Act for inventions patented abroad.

(2.) Where two or more persons declare themselves to be the joint inventors of an invention within the meaning of this Act, a patent may be granted to them in their joint names, subject to the like provisions as in the case of a single patentee

7.—(1.) Where a grant of privilege has been made by letters patent or otherwise for the monopoly or exclusive use or exercise abroad of an invention, a patent for that invention can only be granted to the foreign or colonial grantee, or his legal personal representative (by himself his attorney or agent); and can only be granted to him on his written application within *twelve* months from the date of the foreign or colonial grant, or of the earliest of them if more than one, or where the same is or are existing at the commencement of this Act, then within *twelve* months after the commencement.

(2.) The patent if granted, shall not be affected by the publication of the invention in the United Kingdom the Channel Islands or the Isle of Man by means only of the circulation or republication therein within those *twelve* months of copies of any foreign or colonial grant in respect of the invention or of any specification or other document connected with that grant.

(3.) The patent if granted shall not be affecte

as to duration or otherwise by the expiration or determination in any other manner of the foreign or colonial grant.

(iii.)—*Commissioners of Patents and Examiners.*

8.—(1.) There shall be a Board of Commissioners of Patents for Inventions, in this Act referred to as the Commissioners:

(2.) At any time after the passing of this Act her Majesty may, by warrant under the Sign Manual, appoint three persons to be Commissioners, of whom one shall be experienced in engineering, one shall be experienced in chemistry, and one shall be experienced in the law:

(3.) On the occurrence of any vacancy her Majesty may from time to time in like manner appoint a person of qualifications similar to those of the vacating Commissioner to fill the vacancy:

(4.) The Commissioners shall have an official seal, and impressions thereof shall be judicially noticed and admitted in evidence.

9.—(1.) The Commissioners may from time to time after the passing of this Act, subject to the approval of the Treasury, appoint such persons qualified by knowledge of manufactures or science or arts, as they see fit, to be Examiners of Patents.

(2.) The instrument of appointment shall in each case state the opinion of the Commissioners that the person appointed is so qualified.

(iv.)—*Application for Patent.*

10.—(1.) An applicant for a patent must lodge at the Patent-office an application and declaration in the prescribed form, accompanied by a specification describing the nature of the invention (in this Act termed the Provisional Specification).

(2.) Notice of the application, but not of the contents of the provisional specification, shall be published by the Commissioners.

(3.) On the grant or refusal of a patent, or on failure to prefer a request for sealing within the time allowed, the provisional specification shall be destroyed in the Patent-office; and until it is so destroyed its contents shall be kept secret.

11. The publication or public use of the invention after the application and within a period of *nine months* from the date of the application shall not prejudice the grant of a patent for the invention (which protection from the consequences of publication or public use is in this Act referred to as Provisional Protection).

12.—(1.) The application and its accompanying documents shall be referred by the Commissioners to an Examiner, who shall report to them his opinion—

(*a.*) Whether the invention is subject-matter for a patent;

(*b.*) Whether the title of the invention sufficiently indicates its nature, and whether the provisional specification is in accordance with the title.

(2.) A copy of the report shall be furnished to the applicant, and he may within the prescribed time appeal to the Commissioners against it.

(3.) If the Examiner reports against the title and the provisional specification or either of them, and his report is not appealed against, or is affirmed on appeal, the application shall not be further proceeded with, unless the applicant within the prescribed time amends the titl visional specification as the case may b satisfaction of the Commissioners.

(4.) If the Examiner reports that the i is not subject-matter for a patent, the ap may, notwithstanding that his report is on appeal, be proceeded with; but in th every copy of the patent if granted a office copy of the specification shall bea short statement of the report of the Exa

13.—(1.) At any time during, and not *three* months before the expiration of, t of provisional protection, the applicant m at the Patent-office a further specificatio ticularly describing and ascertaining the of the invention and in what manner it i performed (in this Act termed the Complet fication or the Specification) together with a request for the sealing of the patent.

(2.) If he fails to do so, the provisional tion shall cease and the application shall proceeded with, save by special leave of t missioner, on proof to their satisfaction o able excuse for the failure.

14.—(1). The applicant may, if he t instead of lodging a provisional specificati a complete specification and request for with his application and declaration in instance.

(2.) In that event the provisions of relating to the provisional specification a visional protection shall not apply.

15.—(1.) On the lodging of the comple cation the Commissioners shall again case to an Examiner.

(2.) The Examiner shall report to missioners his opinion—

(*a.*) Whether the complete specifica accordance with the title and wit visional specification (if any); Pro that the applicant shall be allowe time before the Examiner reports, his complete specification by omitt from any matter contained in the p specification.

(*b.*) Whether the claim of the applic fined with sufficient clearness.

(3.) A copy of the report shall be fu the applicant, and he may within the time appeal to the Commissioners again

(4.) If the report of the Examiner on tion submitted to him is adverse to the and is not appealed against or is af appeal, the application may neverthele ceeded with; but in that event every co patent if granted and every office co specification shall bear on it a short sta the report of the Examiner.

16. The Commissioners shall publish plete specification as soon as may be after settled, and thereupon for the residu period of provisional protection, or (whe visional specification has been lodged) months after lodging the complete sp the applicant shall have the like privi rights as might have been conferred b for the invention sealed as of the d application.

17.—(1.) The Commissioners shall pu

ıppointed by them for considering the atent.

ɔerson may, within the prescribed time, ɔ the Commissioners of his intention e grant, on the ground of the appli- obtained the invention from him, but ground.

Commissioners shall hear such person, pinion entitled to be heard, as well as t, before the expiration of the period of protection, or (where no provisional has been lodged) of the *nine* months g the complete specification.

ı decision of the Commissioners is in e grant, the Commissioners shall cause ɔut and sealed with their seal a patent in the second schedule to this Act, or r form as may be prescribed.

Every patent shall be dated the day of for it [save that, where the Commis- rect, a patent may be dated the day of or any day between the day of the ınd the day of sealing.]

r patent shall be sealed as of the day

it shall not be competent for the take any proceeding in the respect of ıent of the patent committed before ion of the complete specification.

erm limited in every patent for the reof shall be *seventeen* years from its

patent when sealed shall have effect the United Kingdom the Channel the Isle of Man.

Every patent shall notwithstanding erein or in this Act, cease at the end h or the *eighth* year of its term, unless ı and in the *eighth* year respectively of patentee takes out at the Patent-office of renewal which shall be granted on n writing.

ɔvertheless, in any case, by accident inadvertence, the patentee fails so to ertificate of renewal, he may prefer a ıe Commissioners for an enlargement 'or taking it out.

upon the Commissioners may if they large the time accordingly, but not in as to extend beyond *six months* from he *fourth* or the *eighth* year aforesaid may be).

roceeding shall be taken in respect of ıent committed within the enlarged 7 special leave of the Commissioners.

—Amendment of Specification.

An applicant for a patent or patentee written request to the Commissioners amend his complete specification by ınation or disclaimer, stating reasons st.

equest shall be published by the Com- nd the applicant or patentee shall be port thereof by an Examiner, or the rs, in the prescribed manner.

equest shall be granted by the Com- ı their being satisfied that the amend- t make the specification comprise an invention substantially larger than or substantially different from the invention originally claimed.

(4.). Any person giving notice within the prescribed time to the Commissioners of objection to the amendment on the ground that it would make the specification comprise an invention substantially different from the invention originally claimed, shall be heard in support of his objection.

(5.) An amendment shall not be admissible in evidence in a proceeding for an infringement alleged to have taken place before an amendment, nor in any proceeding pending at the time of request for leave to amend, except a proceeding for revocation of the patent.

(6.) Leave to amend shall be conclusive as to the right of the party to amend, except in case of fraud.

(vi.)—*Prolongation of Patent.*

24.—(1.) A patentee may within the prescribed time before the expiration of his patent apply to the Commissioners for a prolongation of its term:

(2.) The Commissioners shall publish notice of the application, and of the time fixed for hearing it:

(3.) Any person interested (including a representative of the Crown if interested but not otherwise) may on giving the prescribed notice to the patentee appear at the hearing and oppose the application:

(4.) The decision of the Commissioners on the right, (if challenged) of any person to appear, is final.

25.—(1.) The Commissioners after hearing the case may refuse the application, or may order the prolongation of the term of the patent for any period not exceeding *eleven* years, as they may see fit:

(2.) In determining the case the Commissioners shall have regard to all the circumstances, and in particular to the merit and utility of the invention, to the patentee's expenditure of labour and money, and to the amount of his profits as patentee, considered in relation to the benefit derived by the public:

(3.) It shall not be competent for the Commissioners to impose any conditions in respect of an order for prolongation:

(4.) The order shall be endorsed on or annexed to the patent, and the term of the patent shall be prolonged accordingly.

(vii.)—*Stamp Duties.*

26.—(1.) There shall be paid to and for the use of the Crown on the several instruments described in the *third* schedule to this Act the Duties in that schedule mentioned and no others:

(2.) Those duties shall be under the management of the Commissioners of Inland Revenue, and shall be deemed stamp duties within the Stamp Duties Management Act 1870 and other Acts relating to stamp duties, particularly those relating to forgery fraudulent dies and other offences in connexion with stamp duties:

(3.) Any of the stamps may be adhesive if the Treasury think fit.

(viii.)—*Crown.*

27.—(1.) A patent shall have to all intents the

like effect as against her Majesty the Queen her heirs and successors as it has as against a subject:

(2.) But for purposes of the naval or military service of the Crown one of her Maj sty's principal Secretaries of State or the Lords Commissioners of the Admiralty may, by their officers agents contractors or others, at any time after the application for the patent, use the invention on terms to be before or after the use thereof agreed on, with the approval of the Treasury, between some duly authorised representative of the Crown and the patentee, or in default of such agreement to be settled by the Commissioners after hearing the representative of the Crown and the patentee, if desirous respectively of being heard:

(3.) All expenses of the hearing shall be paid as part of the expenses of the Commissioners in the execution of this Act.

(ix.)—*Assignment and Licenses.*

28. A patentee may assign his patent for England, or for Scotland, or for Ireland, as effectually as if the patent were originally granted to extend to England only or to Scotland only or to Ireland only.

29.—(1.) On complaint and proof to the satisfaction of the Commissioners—

That by reason of default of the patentee to grant licenses or otherwise, the reasonable requirements of the public with respect to his invention cannot be supplied; *or*

That any person is in possession of an improvement on the invention which he is prevented from working or using, by reason of the patentee refusing to grant him a license on reasonable terms;

Then and in either of such cases the Commissioners may, on the application of any person interested, order the patentee to grant licenses on such terms as to amount of royalties, security for payment, leave to the patentee to use any improvement, and otherwise, as to them, having regard to the nature of the invention and to all the circumstances of the case, may appear just.

(2.) On complaint and proof to the satisfaction of the Commissioners that a patentee has failed to comply with an order made under this section, the Commissioners may, if they think fit, after hearing the patentee if desirous of being heard, either require him to give security for his compliance, or may revoke his patent without prejudice to the rights of existing licensees.

[(3.) But the patentee may, if he thinks fit, in lieu of granting licenses pursuant to an order of the Commissioners, require any applicant for a license to purchase all his rights under the patent at a price to be fixed in default of agreement by the Commissioners.]

(x.)—*Registers of Patents and Proprietors.*

30. There shall be kept at the Patent-office a book or books called the Register of Patents, wherein shall be recorded in chronological order all patents granted under this Act, the lodging of specifications amendments of specifications certificates of renewal prolongations of patents the expiration or revocation of patents, with the dates thereof respectively, and such other matters concerning patents as the Commissioners direct.

31.—(1.) There shall be kept at the Pa a book or books called the Register of Pr wherein shall be recorded any assign patent or of any share or interest therei license under a patent and the expiratio

(2.) Until an entry of an assignment o or of any share or interest therein or an license under a patent, is made in the R Proprietors, the original patentee shall to be the sole proprietor of the patent, have granted any license thereunder.

(3.) An entry in the Register of Propr be proof of the assignment or license or ship, as therein expressed, until the c proved.

32. The Register of Patents and the R Proprietors, or copies thereof respectivel open to public inspection, on payment of exceeding *one shilling*, and subject to an tions made by the Commissioners.

33.—(1.) The High Court of Justice in or a judge thereof, may at the instan person deeming himself aggrieved by made under colour of this Act in the R Patents or the Register of Proprietors, order for expunging or varying that e with respect to the costs of the proceedi court or judge thinks fit:

(2.) The entry shall be expunged or var ingly.

(xi.)—*Revocation of Patents.*

34. The proceeding by *scire facias* t patent is hereby abolished.

35.—(1.) A patent may be revoked by missioners on the petition of any person on any of the following grounds:—

(*a.*) That the invention is not new meaning of this Act;

(*b.*) That the patentee is not the tru

(*c.*) That the specification is insu misleading:

(2.) Where a patent has been found the Commissioners in a proceeding fo ment, it shall, unless within the presc the ground of invalidity is removed by a of the specification, be revoked by the sioners.

36. Where a patent for an invention fraud of the true inventor is revoked by missioners on the petition of the true in Commissioners may, if they see fit giv inventor his costs of the hearing as betwe and client.

(xii.)—*Foreign Vessels.*

37.—(1.) A patent shall not prevent an invention for the purposes of the na a foreign vessel within the jurisdiction Her Majesty's Courts in the United Ki the use of an invention in a foreign v that jurisdiction, provided it is not u for or in connexion with the manufact paration of anything intended to be so ported from the United Kingdom:

(2.) But this section does not exten of any foreign State in whose territo subjects do not enjoy equal benefits in the subject-matter of this section.

—*Industrial and International Exhibitions.*

—he publication or use of an invention at
industrial exhibition or at any international
ion for the purposes of such exhibition and
the place where it is held shall not, nor
ae publication or use elsewhere by any person
t the consent and privity of the inventor, be
a publication or use so as to prejudice the
of the inventor his executors administrators
gns to lodge an application for a patent for
vention at any time within *eighteen months*
he opening of the exhibition, nor invalidate
atent that may be granted for the invention.
and for the purposes of this section the ex-
on industrial exhibition has the same meaning
e Industrial Exhibitions Act, 1865: the ex-
ion international exhibition has the same
ing as in the Protection of Inventions Act,

(xiv.)—*Fraud. Offences.*

A patent granted to the true inventor shall
e invalidated by an application in fraud of
r by provisional protection obtained thereon,
any publication or use of the invention con-
nt on that fraudulent application.
If any person makes or causes to be made a
entry in the Register of Patents or in the
ter of Proprietors, or a writing falsely pur-
g to be a copy of an entry therein, or pro-
or tenders or causes to be produced or
ed in evidence any such writing knowing
try or writing to be false, he shall be guilty
isdemeanour.
In each of the following cases, that is to

a.) If any person writes paints prints moulds casts carves engraves stamps or otherwise marks on anything made used or sold by him in respect whereof he has not a patent, the name or any imitation of the name of any other person who has a patent in respect thereof, without the leave in writing of the patentee;

b.) If any person, or any such thing, not having been purchased from the patentee or from some person who purchased it from or under the patentee, or not having had the license or consent in writing of the patentee, writes paints prints moulds casts carves engraves stamps or otherwise marks the word Patent or the words Letters Patent, or any words of the like kind or meaning, with a view of imitating or counterfeiting the stamp mark or other device of the patentee, or in any other manner imitates or counterfeits the stamp mark or other device of the patentee;

ry such person shall for every such offence
ble to a penalty not exceeding *fifty pounds*,
recovered by action or other proceeding or
nation in the High Court of Justice, one-half
of to be paid to the Treasury, for the use of
ublic, and the other to the person who sues.
If any person wilfully and corruptly lodges
ses to be lodged at the Patent-office any
ibed declaration knowing it to be untrue in
material particular, he shall be guilty of a
meanour.

(xv.)—*Supplemental as to Procedure.*

43.—(1.) The Commissioners and Examiners may for purposes of this part of this Act administer and take or cause to be administered and taken oaths and declarations:

(2.) If any person in any testimony given on oath or affidavit or in any declaration made under this section wilfully and corruptly makes a statement false in any material particular, he shall be guilty of perjury.

44.—(1.) Notwithstanding anything in this Act, an applicant for a patent may from time to time obtain from the Commissioners, if and as far and on such terms (if any) as the Commissioners think fit, and whether the original period is expired or not, an extension of the period of provisional protection, not exceeding *twelve months* in the whole from the date of the application for the patent.

(2). In every such case everything done or happening within the extended period shall have effect as if it had been done or had happened within the period originally allowed.

45.—(1.) Where the Commissioners or an Examiner hear an opponent, they or he may if they or he think fit direct by and to whom the costs of the hearing and proceedings connected therewith or any part thereof shall be paid, and how and by whom the amount thereof shall be ascertained.

(2.) If any costs so directed to be paid are not paid within *four days* after service of notice of the amount thereof so ascertained on the party liable to pay the same, the Commissioners may make an order for payment thereof, and that order may be made a rule of the High Court of Justice.

(3.) This section does not extend to empower the Commissioners to direct the costs of opposition to an application for prolongation to be paid by the patentee, in the absence of fraud or misconduct on the part of the patentee.

46.—(1.) An opponent of the grant of or of the amendment of a patent, and an applicant for revocation of a patent, must deliver the prescribed particulars of the objections on which he relies.

(2.) Evidence in proof of an objection of which particulars have not been delivered is not admissible, save by leave of the Examiner or Commissioners hearing the case.

(3.) Particulars delivered may be from time to time amended by leave of the Examiner or Commissioners hearing the case.

47.—(1.) On any opposition to grant of a patent and on any petition for revocation of a patent, the Commissioners may, and on the request of either party shall, obtain the assistance of an expert as assessor.

(2.) In appointing an assessor the Commissioners shall have regard to the wishes of the parties, if they agree.

(3.) The duty of an assessor is to give his opinion on any question at the request of the Commissioners, and on any other question which he deems important for the decision of the case, but he has no voice in the decision.

(4.) The remuneration of an assessor may be paid as part of the expenses of the execution of this Act, or by the parties as part of the costs of the proceedings, or partly in one way and partly in the other, as may, subject to general rules, be directed by the Commissioners.

(xvi.)—*Supplemental as to Commissioners.*

48.—The Treasury shall provide an office for the Commissioners called the Patent-office, with a museum and library, and any other buildings that may be requisite for purposes of this Act.

49. There shall be paid out of money provided by Parliament to each Commissioner such yearly salary not exceeding [ ] and to the Examiners such yearly salaries not exceeding in the case of any Examiner [ ] as the Treasury determine.

50.—(1.) The Commissioners may from time to time after the passing of this Act, subject to the approval of the Treasury, appoint so many clerks and officers as they think fit, and may, from time to time remove any of those clerks and officers.

(2.) The salaries of those clerks and officers shall be fixed by the Commissioners subject to the approval of the Treasury, and the same and the current and the incidental expenses of the Commissioners in the execution of this Act shall be paid out of money provided by Parliament.

51. The Commissioners may at any time after the passing of this Act and from time to time (subject to the provisions of this Act) make vary and rescind general rules for prescribing and regulating—

(*a.*) The form and contents of applications specifications drawings declarations objections certificates reports amendments patents and other documents, and of copies and extracts, and the lodging making recording issuing publishing and inspecting, and otherwise proceeding on and dealing with the same or any of them;

(*b.*) The evidence and procedure on hearing applications oppositions and petitions for prolongation or revocation;

(*c.*) The advertisement in a journal to be published periodically by the Commissioners or otherwise, of all matters whereof notice is required to be published by the Commissioners under this Act;

(*d.*) The keeping of the Register of Patents and of the Register of Proprietors:

(*e.*) The opening to public inspection, and the publication and sale of copies of specifications drawings models amendments reports and other papers.

(*f.*) The presentation of copies of the publications of the Commissioners to public libraries and museums, literary and scientific bodies and official authorities, in the United Kingdom and abroad:

(*g.*) The making printing publishing and selling of indexes to and abridgments of specifications and other documents in the Patent-office:

(*h.*) The admission of the public to the museum and library provided under this Act:

(*i.*) The remuneration (subject to the approval of the Treasury) of assessors:

(*k.*) And generally for prescribing and regulating the management of the Patent-office museum and library, and all things by this Act placed under the direction or control of the Commissioners.

52.—(1.) All general rules made under this Act by the Commissioners shall as soon as n
they are made be laid before both
Parliament if Parliament be sitting; an
ment be not sitting then within *fourt*
the commencement of the next Session

(2.) If within *six weeks* of any rul
before Parliament either House resol
same ought to be disallowed, that r
invalid and of no effect, without preju
theless to any operation of the rule
allowance.

(3.) A rule though made before, doe
case take effect till after, the comme
this Act.

53. Copies or extracts of or from the
Patents and the Register of Proprietor
from specifications amendments and
ments in the Patent-office, shall, if
behalf of and sealed with the seal of
missioners, be admitted in evidence in a
her Majesty's dominions, and in all p
without further proof and without pro
the originals.

54. The Commissioners shall cause a
specting the execution by or under th
Act to be laid annually before both
Parliament, together with an account
salaries and other moneys received and
this Act.

55.—(1.) Not less than two Commissi
sit on the hearing of any opposition to
or prolongation of a patent, or of an
for revocation of a patent or of any
to the remuneration to be paid by the
use of an invention or as to the grant

(2.) Not less than two Commissio
concur in the making of any general r
the appointment or removal of any exa
or officer:

(3.) Subject as aforesaid and to a
rule of the Commissioners, any pow
Commissioners under this part of this A
exercised by any one or more of them:

(4.) Any Act of the Commissioners s
invalid by reason only of any vacan
body or of the power to appoint any Co
not having been exercised.

56.—(1.) During a vacancy in the offic
the illness or absence of any Commi
whenever for any other reason the Con
deem expedient, an Examiner may be
by writing under the hands of two Con
to act as and exercise all the powers
missioner under this part of this Act.

(2.) Any such appointment shall be
not exceeding *six* months, but may be r

PART II.

Infringement of Patents.

57. An action or other proceeding fo
ment of a patent shall not after the
ment of this Act be commenced in a
Majesty's Courts of Justice in England.

58. For the purposes of this Act s
deemed to infringe a patent if he copies
or in part the invention of a patentee
view of effecting the same or a like
fails to establish any of the pleas s
this Act in a proceeding for infringemen

.—(1.) A patentee may complain of any in-gement of his patent to the Commissioners.

.) The complaint shall be heard and deter-ed by the Commissioner (other than the legal missioner) who is best acquainted with the ect-matter of the complaint, assisted by a legal sor to be appointed for the purpose by the missioners.

.) An appeal shall lie from the decision of the anal thus constituted to the three Commis-ers, who shall hear the complaint *de novo*, and r decision shall be final.

.) The Commissioner or Commissioners sitting hear any complaint may decide all questions w and fact; they may by themselves or by person appointed by them enter and inspect place or thing being the property or under the trol of any party to a proceeding before them; may require the attendance of any person as ness and the production of books and papers ing to the matter before them; generally may (subject to the provisions of this Act) cise all such jurisdiction and powers and such orders as might have been exercised made in a like case by any division or judge he High Court of Justice in England.

. The pleas allowed by this Act in a proceed-under this Act for infringement of a patent —

That the particular matters alleged to be infringed, do not show sufficient invention to justify the grant of a patent, or are not new within the meaning of this Act;

That the patentee is not the true inventor of the invention or of so much of it as is alleged to be infringed;

That the matters complained of do not amount to infringement;

That the claim of the patentee as respects the matters complained of is not stated with sufficient clearness;

That the specification is, as respects the matters complained of, incomplete or misleading.

That the patentee as respects any matter complained of withheld that which he knew to be a better description than that given in the specification.

.—(1.) In a proceeding for infringement of a nt the complainant must deliver the prescribed ticulars of the infringement complained of:

.) The defendant must deliver the prescribed ticulars of objections on which he relies in port of his pleas or plea:

.) In every case the particulars delivered shall prise a statement of the places and manner at in which the complainant or defendant alleges infringement to have been committed, or the and things on which he founds the objections have been done or to have happened, or the ation to have been, before the date of the t published or used.

.) At the hearing no evidence shall, except by of the Commissioners, be admitted in proof y alleged infringement or objection of which culars are not so delivered:

.) Particulars delivered may be from time to amended, by leave of the Commissioners.

.) On taxation of costs regard shall be had to the particulars delivered by the complainant and by the defendant; and they respectively shall not be allowed any costs in respect of any particular delivered by them unless the same is certified by the Commissioners to have been proven or to have been reasonable and proper, without regard to the general costs of the case.

62. In any proceeding for infringement of a patent the Commissioners may, and on the application of either party shall, obtain the assistance of an expert as assessor; and the provisions of Part I. of this Act relative to experts as assessors (including the provision as to remuneration) shall apply as if they were repeated in this section.

63.—(1.) The Commissioners may at any time after the passing of this Act and from time to time make vary and rescind rules of procedure prescribing and regulating—

(*a.*) The form nature and service of complaints particulars notices and other documents;

(*b.*) The period within which anything is to be done in a proceeding for infringement;

(*c.*) The nature and amount of security for costs to be given by complainants and others;

(*d.*) Generally the sittings of the Commissioners and the procedure on all matters brought before them under this part of this Act.

(2.) Every rule made under this part of this Act by the Commissioners shall as soon as may be after it is made be laid before both Houses of Parliament if Parliament be sitting; and if Parliament be not sitting then within *fourteen* days of the commencement of the next Session:

(3.) If within *six* weeks of any rule being laid before Parliament either House resolve that the same ought to be disallowed, that rule shall be invalid and of no effect, without prejudice nevertheless to any operation of the rule before disallowance:

(4.) A rule though made before, does not in any case take effect till after the commencement of this Act.

64.—(1.) Every person required by the Commissioners to attend as a witness shall be allowed such expenses as would be allowed to a witness attending on subpœna in the High Court of Justice in England.

(2.) In case of dispute as to the amount to be allowed, the same shall be referred to a master of the High Court of Justice, who, on request under the hands of the Commissioners, shall ascertain and certify the proper amount of such expenses.

65.—(1.) Any decision and any order made by the Commissioners under this part of this Act may be made a rule or order of the High Court of Justice, and shall be enforced in like manner as any rule or order of such Court.

(2.) For the purpose of carrying into effect this section general rules and orders may be made by the same authority and in the same manner as general rules and orders may be made with respect to any other proceedings in such Court.

66.—(1.) Where a patent bears on it a statement of the report of an Examiner in accordance with the provisions in that behalf of Part I. of this Act, then in the event of a patentee instituting any proceeding for infringement of the patent he

shall give security for costs of such amount (not being less than *one hundred* pounds) as the Commissioners think fit to order; and if he fails in the proceeding on any ground indicated in the said report he shall pay the costs of the defendant as between solicitor and client.

(2.) Subject as aforesaid the costs of and incidental to any proceedings before the Commissioners under this part of this Act shall be in the discretion of the Commissioners.

67. The costs charges and expenses of and incidental to any proceedings before the Commissioners which are incurred by any person shall if required be taxed in the same manner and by the same persons as if such proceedings were proceedings in the High Court of Justice.

68. This part of this Act does not extend to Scotland Ireland the Channel Islands or the Isle of Man.

PART III.

General Provisions.

69. Every document purporting to be signed by the Commissioners or any of them shall be received in evidence without proof of such signature and until the contrary is proved shall be deemed to have been signed and to have been duly executed or issued by the Commissioners.

70. The Public Offices Fees Act, 1866, shall apply to all fees taken in relation to any proceedings before the Commissioners.

Any fee or payment in the nature or lieu of a fee paid in respect of any proceedings before the Commissioners and collected otherwise than by means of stamps shall be paid into the receipt of her Majesty's Exchequer in such manner as the Treasury from time to time direct, and carried to the Consolidated Fund.

71.—(1.) Any notice required or authorised to be given under this Act may be in writing or in print or partly in writing and partly in print, and may be sent by post:

(2.) If sent by post a notice shall be deemed to have been received at the time when the letter containing the same would have been delivered in the ordinary course of the post:

(3). In proving such sending it shall be sufficient to prove that the letter containing the notice was prepaid and properly addressed and put into a post-office.

PART IV.

(i.)—*Transitory Provisions.*

72.—(1.) Every patent granted before the commencement of this Act, shall have such duration only as it would have had if this Act had not been passed; but as regards the third and the seventh year (if unexpired at the time of the commencement of this Act) of its term it shall, notwithstanding anything in any such patent contained be subject to stamp duties of *Thirty* pounds and *Sixty* pounds respectively and to no others; and the provisions of this Act respecting a certificate of renewal and respecting accident mistake or inadvertence in relation thereto shall also extend to every such patent:

(2.) The provisions of this act relating to the Crown and to the power of the Commissioners to order a patentee to grant licenses shall not extend to patents granted before the commen[cement of] this Act:

(3.) Any action or other proceeding in [respect of] a patent pending at the commencement [of this Act] shall be tried and continued in like ma[nner as if] this Act had not been passed:

(4.) The term of a patent granted [before the] commencement of this Act may be pro[longed for] any period not exceeding *fourteen* yea[rs as the] Commissioners may see fit:

(5.) In all other respects this Act shal[l apply to] all patents granted before the commen[cement of] this Act in substitution for such ena[ctments as] would have applied thereto if this Act ha[d not been] passed; and in particular such patents [shall be] expressly excepted from the operati[on of the] Statute of Monopolies, and shall not be i[nvalidated] or affected by anything therein contain[ed].

73. The Register of Patents and the [Register of] Proprietors kept under any enactment r[epealed by] this Act shall respectively be deemed p[art of the] Register of Patents and the Register of [Proprietors] kept under this Act.

74. All applications for patents pen[ding at the] passing of this Act shall be heard and [determined] in the interval between the passing an[d the com]mencement of this Act, as if this Act h[ad not been] passed.

75.—(1.) All books documents and oth[er property] of every description vested in or under t[he manage]ment of the Commissioners of Patents [for Inven]tions existing at the commencement [of this Act] shall immediately on its commencement [vest in and] be under the management of the Co[mmissioners] constituted by this Act:

(2.) At the same time the staff of [officers and] servants of the existing Patent-office sh[all, subject] to any other arrangements made by th[e Treasury,] be transferred to the Patent-office und[er this Act] at the like salaries and on the like ten[ure of their] offices and places, and with as nearly [as may be] the like duties as formerly.

76. The repeal of enactments or any [other thing] in this Act contained shall not—

(*a.*) affect the past operation of a[ny of those] enactments or the validity of [any patent] granted, or any compensation [due for] anything done or suffered unde[r any] of those enactments before or [at the com]mencement of this Act; or

(*b.*) interfere with the prosecution o[f any action] or proceeding civil or criminal [pending at] the commencement of this Act [or any part] thereof; or

(*c.*) take away or abridge any pr[otection or] benefit in relation to any such [action or] proceeding.

(iii.)—*Transfer of powers as to Registratio[n of Trade] Marks and Copyright of Designs*

77. All powers duties and authoritie[s] imposed on or exercisable by the existin[g Commis]sioners of Patents under the Acts r[elating to] Registration of Trade Marks, and the Ac[ts relating] to Copyright of Designs, are hereby tra[nsferred to and] vested in and imposed on the Commissi[oners con]stituted by this Act; and those Acts sh[all be read] and have effect accordingly.

(iii.)—*Scotland.*

nalty under this Act in respect of the ed use of a name word stamp mark or be recovered in Scotland by action or eeding or information in the Court of

rder of the Commissioners for payment ay be recorded in the books of Council a in Scotland to the effect that execution hereupon in common form.

(iv.)—*Ireland.*

withstanding anything in this Act, all ll have in Ireland their remedies under ct of a patent as if it had been granted o Ireland only.

(v.)—*Saving for Crown.*

81. Notwithstanding anything in this Act, it shall be lawful for her Majesty the Queen, her heirs or successors, by warrant under the Royal Sign Manual—

To direct any specification to be cancelled before the sealing of the patent, and thereupon the provisional protection shall cease:

To direct the Commissioners to refuse the sealing or issue of a patent:

To direct the insertion in any patent of any restrictions, conditions, or provisoes.

82. Nothing in this Act shall take away, abridge, or prejudicially affect the prerogative of the Crown in relation to the granting of any letters patent, or to the withholding of a grant thereof.

THE FIRST SCHEDULE.

PART I.

Acts partly repealed.

nd Chapter.	Title or Short Title.	Extent of Repeal.
c. 3. [f Monopolies]	An Act concerning Monopolies and Dispensations of Penal Laws and the Forfeiture thereof.	Section six.
c. 69.	An Act for Amending an Act passed in the fourth year of the reign of his late Majesty, intituled an Act for the better Administration of Justice in his Majesty's Privy Council, and to extend its jurisdiction and powers.	Sections two to five, both inclusive.
t. c. 3.	The Industrial Exhibition Act, 1865.	Section three.
t. c. 27.	The Protection of Inventions Act, 1870.	Section two.

PART II.

Acts wholly repealed.

nd Chapter.	Title or Short Title.
IV. c. 83.	An Act to amend the Law touching Letters Patent for Inventions.
c. 67.	An Act to Amend an Act of the fifth and sixth years of the reign of King William the Fourth, intituled An Act to amend the Law touching Letters Patent for Inventions.
t. c. 83.	The Patent Law Amendment Act, 1852.
t. c. 5.	An Act to substitute Stamp Duties for Fees on passing Letters Patent for Inventions, and to provide for the purchase for the public use of certain Indexes of Specifications.
t. c. 115.	An Act to amend certain provisions of the Patent Law Amendment Act, 1852, in respect of the transmission of certified copies of Letters Patent and specifications to certain offices in Edinburgh and Dublin, and otherwise to amend the said Act.
13.	An Act to amend the Law concerning Patents for Inventions with respect to Inventions for Improvements in Instruments and Munitions of War.

THE SECOND SCHEDULE.

Form of Letters Patent.

, by the grace of God, of the United Kingdom itain and Ireland, Queen, Defender of the o all to whom these presents shall come

A. B. hath by his petition humbly repre- us that he is in possession of an invention

ation is described in the specification annexed hereto, and the petitioner hath also represented to us that the said invention will be useful to the public, that he is the true inventor thereof, and that the same is not in use by any other person to the best of his knowledge and belief:

And whereas the petitioner hath humbly prayed that we would be graciously pleased to grant unto him (hereinafter together with his executors, administrators, and assigns, or any of them referred to as the said patentee) our Royal Letters Patent for the sole use and advantage of his said invention within our United

Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man.

And whereas we being willing to encourage all inventions which may be for the public good, are graciously pleased to condescend to the petitioner's request:

Know ye, therefore, that we, of our especial grace, certain knowledge, and mere motion do these presents, for us, our heirs and successors, give and grant unto the said patentee our especial licence and full power and sole privilege, that the said patentee by himself his agents or licensees and no others may at all times hereafter during the term of years herein mentioned make use exercise and vend his said invention within our United Kingdom of Great Britain and Ireland the Channel Islands and Isle of Man in such manner as to him may seem meet and that the said patentee shall have and enjoy the whole profit and advantage from time to time accruing by reason of the said invention during the term of yeers herein mentioned; To hold exercise and enjoy the said license powers and privileges unto the said patentee during the term of *seventeen* years from the day of : And to the end that the said patentee may have and enjoy the sole use and exercise and the full benefit of the said invention we do by these presents for us our heirs and successors strictly command all our subjects whatsoever within our United Kingdom of Great Britain and Ireland the Channel Islands and the Isle of Man that they do not at any time during the continuance of the said term of *seventeen* years either directly or indirectly make use or put in practice the said invention or any part of the same nor in any wise imitate the same nor make or cause to be made any addition thereto or substraction therefrom whereby to pretend themselves the inventors thereof without the consent licence or agreement of the said patentee in writing under his hand and seal on pain of incurring such penalties as may be justly inflicted on such offenders for their contempt of this our Royal command and of being answerable to the patentee according to law for his damages thereby occasioned: Provided that these our letters patent are liable to be revoked on the grounds and in the manner from time to time by law provided: Provided also that if the said patentee shall not pay all stamp duties by law required to be paid in respect of the grant of these letters patent or in respect of any matter relating thereto at the time or times and in manner for the time being by law provided and also if the said patentee shall not supply or cause to be supplied for our naval or military service all such articles of the said invention as may be required by the officers or Commissioners administering any department of those services respectively in such manner at such time and at and upon such reasonable prices and terms as shall be settled in manner for the time being by law provided that then and in any of the said cases these our letters patent and all privileges and advantages whatever hereby granted shall determine and become void notwithstanding anything hereinbefore contained: But nothing herein contained shall prevent the granting of licenses in such manner and for such considerations as they may by law be granted: And lastly, we do by these presents for us our heirs and successors grant unto the said patentee that these our Letters Patent shall be constructed in the most beneficial sense for the advantage of the said patentee. In witness whereof we have caused these our letters to be made patent this One Thousand Eight Hundred and in the year of our reign and to be sealed as of the said One Thousand Eight Hundred and

By Order

Specification.

To all to whom these presents shall come:

I, A. B., of send greeting:

* *Whereas* I the said A. B., on the day of lodged in the Patent-office a provisional specifica the invention herein mentioned and applied for of a patent for my said invention unto me t A. B., my executors administrators and assigns know ye that I the said A. B. do hereby dec nature of my said invention and in what ma same is to be performed to be particularly desc and by the following statement (that is to say,)

[*Describe the Invention.*]

In witness whereof I have hereunto set my h seal this day of A.D.

(L.

* Note.—If no provisional specification was lodged will run:—*Whereas* I the said A. B., on the day of applied for a grant of a patent for the invention herein unto me, &c.

THE THIRD SCHEDULE.

Stamp Duties.

On application ....
On grant of patent ....
On expiration of 4th year of patent ....
On expiration of 8th year of patent ....
On application to amend specification ......
On order giving leave to amend............
Prolongation of patent—for each year of prolongation..............................
On certificate of record of notice of appeal against decision of Examiner............
On certificate of record of notice of opposition to any application....................

CANTOR LECTURES.

WATCHMAKING,

By Edward Rigg, M.A.

Lecture III.—Delivered Monday, Feb

Necessity of efforts to promote the art in th —Need of education, theoretical and pra horology—Literature—Great want of u in gauges, screws, &c.—Exhibition of and complicated watches, and of wat tools—Conclusion.

The published syllabus of this third lect me feel very strongly that some explana as far as possible, justification of the matter therein mentioned is due to my more especially when the technical cha the last lecture is borne in mind. But, re ing the object with which this Soci originally formed, and which it has for a and a quarter steadily kept in view, the p of arts, manufactures, and commerce, I fe some grounds for hoping that those w seriously thought of the condition of the ho art in this country will admit that I c fairly have taken a very different course. making is an art in a very high sense of t and, in addition to being of universal in is well deserving of scientific investigation from the fact that it brings the worker in relation with many abstruse physical for

ps any other branch of mechanics; and it is xtravagant to hope that it will in the future us to a fuller knowledge of them. And yet mount of attention it has received from men ence has been very small, especially in this ry. Most of its truths have been arrived at, y scientific reasoning, but by pure experiment bservation, and most of the treatises on ogy consist rather of statements of facts and ptions of apparatus than of any logical train ument. One consequence of this is that the great ity of those engaged in the art regard science no way a concern of theirs, and, as Saunier ointed out, are not unfrequently ready to offence at any suggestion that they could t by a knowledge of it. As an instance of take the case of the best form of teeth of . No mechanician doubts the advantages cycloidal or involute teeth, but how often is hmaker found to believe in them as bearing trade? He knows that if his cutter is of a which experience has shown to be satisfactory, good depth may be secured, but he ignores ct that this vaunted experience has only led, or less accurately, to the discovery of one ner of those forms that were proved by matical investigation to be the best more century ago.

le the industry would have materially ed in the past by the aid that science had r, a specially adapted scientific training is han ever necessary to its well-being in the . In face of the eager competition by which sailed at the present day, we may be certain cannot remain stationary, and if there is od evidence to show that advance is made, y safely conclude that it is in a decaying

not only is all knowledge of science omitted ne training of the watchmaker; now-a-days, ne manual skill is in great part wanting, and general complaint that no sufficient supply npetent young workmen is to be found to he place of the older men; indeed, I am d that practically the whole of the best work kenwell is now performed by men advanced rs. This has resulted from the failure of the stem of apprenticeship and the neglect to e a substitute, a change in our social con- which has more than once been discussed in oom.

of two results must necessarily follow from state of things, and that very shortly: stic steps must be taken to provide for the tion, both theoretical and practical, of our young workmen, or the quality of est English work must rapidly deteriorate. this urgent need of technical education has essed itself upon the attention of every watch- ng community, those on the Continent, already ession of schools, doing all in their power nce their utility and increase their number, America, notwithstanding the minute ation of its machinery, is fully alive to their ity.

tzerland already possesses six such schools, ny two, and France three, that of Paris only been opened on the 6th of March in esent year. As showing how its importance stantly borne in mind by the watchmakers of that city, I would mention that for seven years a subscription list has been open for the purpose of establishing a school of watchmaking, and their private exertions have at length secured a sum sufficient both for the establishing and maintenance of such a school.

In England, however, the special instruction hitherto available for watchmakers has been very slight, consisting mainly of drawing classes and occasional lectures on technical subjects at the Horological Institute. But in the early part of last year very important additions were made to the instruction there given, through the liberality of the City and Guilds of London Institute for the Promotion of Technical Education; and, thanks to them, we now possess a horological school whose immediate future must have a marked influence on the progress of English watchmaking, and will be looked to with no little interest by all who desire the art to prosper in this country. Indeed, I think it has a wider interest. Technical instruction has for many years had its eager advocates, among whom I may be permitted to mention my late father as having been the first to organise, 35 years ago, classes for the teaching of various trades, such as carpentry, mechanical engineering, printing, bookbinding, glass staining, &c., at Chester; but never was public attention so thoroughly directed to its necessity as it is at the present day. This school of horology is one of the first founded by the City Guilds Institute, and I doubt whether they could have selected a trade more suitable for the purpose of demonstrating the practicability of technical education among us. For the experiment can be made efficiently without the purchase of a very elaborate plant, theoretical and practical instruction can easily be carried on side by side, and the student can be placed in conditions similar to those in which he will find himself in after life. A further recommendation consists in the fact, that the scheme admits of a gradual extension, so as ultimately to include all the allied branches of the trade, such as dial and case-making and engraving, as well as to clock and chronometer making, and to that most important but sadly neglected branch, tool making. At the same time a rapid advance must not be looked for, for the art is of such a character as to require a special preliminary training of the pupils, so that the more or less complete want of this instruction will render their progress proportionately slow.

The school has existed since the summer of last year. In addition to the various branches of the art to which the pupils devote four full days a week, there are classes and lectures for instruction in the elementary principles of physics and mechanics that have a bearing on horology. It is gratifying to observe that all the benches at present available for practical pupils are occupied, and the progress they have hitherto made justifies a hope that the experiment will prove to be in every way successful. Systematic instruction has been one of the urgent wants of the watchmakers of this country for at least half a century; with the powerful support of the City Guilds they now have an opportunity, such as many of the continental centres of the industry may well envy, and it is for them to see that the most active encouragement is given to the experiment. In the

face of a steady depression in trade, the English watchmakers have, with most praiseworthy efforts, erected a Horological Institute; it remains for them to continue their exertions, in order to ensure success in the application of that Institute to its legitimate uses.

On one point I would venture to make a special appeal. The practical classes are necessarily limited in number by the space available, and although it is earnestly to be hoped that means may, ere long, be found to increase the accommodation, they must always be, in a sense, inelastic. But this is not the case with the lectures or theoretical classes, and if those actually engaged in the trade could, as a body, be brought to perceive that a scientific knowledge of their art is often even more essential than manual skill as a means of securing real progress, all the more so because the art is already in a highly advanced state, the theoretical instruction provided would not be confined, as it now is, entirely to the practical students. The Technological Examinations of the City Guilds Institute—examinations which have for many years been carried on, in various trades, with such signal success by this Society—may be expected to form an additional inducement to the younger members of the trade to join these or other similar classes, even although it involves the devotion of a few of their working hours to study. The prizes, medals, and certificates will constitute guarantees of a certain amount of theoretical knowledge such as have never existed in this country before, and it is not too much to expect that the higher standard of education to be secured by these means will immensely facilitate the introduction of some of the other improvements to which reference has already been made.

As the reduction in the number of men competent to undertake high-class work may be traced to the gradual failure of the old apprenticeship system, so the general lowness in the standard of theoretical knowledge is undoubtedly in great part due to the want of a special literature. It is simply incredible that English horology should have attained the eminence it certainly has attained without possessing a single treatise that could pretend to be even approximately complete. A partial exception should, perhaps, be made on behalf of Thomas Reid's volume, "On Clock and Watchmaking," published in 1826, but he directed his attention mainly to clockmaking. There are, of course, trade journals, &c., but the watch and chronometer may be said to have been ignored except in such volumes as those of Harrison, Mudge, Earnshaw, and others who had special inventions of their own to describe. And this may, perhaps, help to account for the neglect of the subject by the public, notwithstanding a few small treatises written for their edification. As I incidentally observed in the first lecture, France is exceptionally well supplied in this respect, as witness the elaborate works of Thiout, Berthoud, Lepaute, Dubois, Moinet, the more recent "Traité d'Horlogerie Moderne" of M. Saunier, and the many profound investigations into the theory and use of the marine chronometer, which were lately published, in a collected form, by M. Ledieu, in a work on the "New Methods of Navigation." M. Saunier's work, thoroughly practical, and, at the same time, constituting a scientific discussion

of the principles involved in watchmaking
as had not previously been attempted,
recognised text-book in use in all the horol
schools of the Continent, and I am
enough to trust that the translation of it,
Mr. Tripplin and myself have recently com
will be of service to the art in this country
as an instrument of education and a w
reference, and as a means of reviving
interest in the subject. Several works
utmost value to the art have come from the
M. Saunier, notably the *Revue Chronom*
now in its twenty-ninth year of publicatio
we hope, before the end of the present
complete the translation of another
volume by the same author, "The Watch
Handbook," which is of a more purely
character, and calculated to afford in
assistance in the daily work of watchmal
repairing.

A brief reference was made at the end o
lecture to the question of standard sizes.
ever steps are taken with a view to est
the English trade on a firmer footing,
questionable that the systems of mea
must come in for an important share of
ation. Various efforts at reform have b
during the last half century, but with no
result, and the late Charles Frodsham, i
pretending but remarkably useful little
of 40 pages, entitled, "A Few Facts Conne
the Elements of Clock and Watchmaking,"
in 1862, threw out a number of importan
tions on the point, which, I believe, have
received but little attention. The comp
the present system, if system it can be
well illustrated by his account of the I
movement gauge. He experienced co
difficulty in discovering the scale by
well-known numbers used to designate
related, and concludes that they represe
sive additions of thirtieths of an inch to
inch, which is called 0, with a constant a
$\frac{1}{30}$ths inch for the "fall," or room to
works to open and shut in the case.
16-size watch will have a diameter of 1 -
or 1·7 inches, which obviously is quite un
with the gauge number, unless the a
happens to be known; and, I would add,
amount is not a constant, for different
turers employ slightly different gau
thus it happens that almost every move
quires a case and dial to be specially ma
The graduation of the pillar gauge, by
distance between the two plates of the
measured, is even more complex. $\frac{1}{72}$th i
pressed by the utterly meaningless combi
$\frac{1}{8}$th inch is called 0, and $\frac{20}{0}$ is equal to $\frac{1}{72}$

In place of all this gratuitous confusion
posed a system of measurement by decim
inch for all parts of the movement, and it
to be desired that some such modificatio
be introduced when the reforms in the w
which are so urgently needed are
would be travelling beyond my present
enter into this question of gauges, but
well deserves discussion, and it would be
to take full advantage of any system
received the cordial support of the
[A very complete collection of the

ıakers, most of which had been lent by imshaw and Baxter, was exhibited, and f uniformity in their systems of graduad out. Sets of standard gauges that l at $\frac{1}{100}$th inch and differed by $\frac{1}{1000}$th also kindly lent by Sir Joseph Whit-

the gauges in ordinary use, such as the ge, and the main-spring gauge, are on an easily intelligible system, and, as foreign manufacture, their basis is in cases the millimètre. They are cheap, accurate for the purposes for which intended, and as a large number of ısed by the generality of watchmakers f continental origin, it seems all but that the inch can be established as a ı the trade, but a double graduation on uges is all that would be required to chmakers to work on either system, as ces might render necessary.

iety of Arts of Geneva has recently d this question of gauges as well as closely allied subject, the threads of l they have proposed certain standards Swiss manufacturers seem disposed to is to be hoped that English makers may ay to introduce the same standards, at ı so far as they are brought in contact ntinental trade.

tworth standards afford an invaluable atchmaking, and when the manufac- . movement makers have come to an ing to work rigidly to them, a very im- p will have been taken towards the ng of the English trade. There are ırtments of the manufacture that are, k, self-contained, and do not directly ontact with the gauges in use on the and for them the value of these standards over-estimated. As bearing on this must not omit to mention that the Department of the Board of Trade has ıade arrangements by which great e offered for verifying gauges of all is system, having procured a complete standards comprising all dimensions inch to six inches. This should constiitional reason for watchmakers taking rganise their systems of measurement. but one other point to which I desire to f reference before proceeding to exhibit, of the electric lamp, a number of various degrees of complexity, which ıs of friends has enabled me to collect ening.

d collection of tools, for the loan of ich I am indebted, as was the case with to Messrs. Grimshaw and Baxter, was rimarily, to show the types of tool that watchmaker or manufacturer on the n employs. It will be seen at once that entirely in design from the machines y other workers in metal, and often the devices used are radically different. ction as this is, of course, not likely to h novelty to watchmakers, but it is y of examination by all who are in mechanical work, as many of present special features that might with advantage be adopted in larger machines. [As examples, mention was made of the pump centre of a mandril, by which almost any piece can be centred with the utmost facility, and the depth tool used in the clock, chronometer, and watch trades for determining the positions of pivot holes, so that wheels and pinions should run smoothly together. A number of the tools were briefly explained, and their special features as compared with those used in other mechanical arts were pointed out. The attention of watchmakers was also drawn to the beautiful series of tools manufactured by M. G. Boley, of Esslingen, Wurtemburg, some of which were exhibited.]

And I had another object in bringing these tools here this evening. I want to draw attention to the very great interest that watchmaking possesses for those that amuse themselves with mechanical pursuits; and, without in any way wishing to decry that most perfect tool, the lathe of, say, four or five inch centre, the usefulness of which, indeed, it would be difficult to over-estimate, I feel very strongly that its smaller relatives have hitherto been too much neglected by amateurs. The tools employed in watchmaking can be obtained at comparatively moderate cost, and lend themselves to great variety of operations on a small scale. They occupy but little room, and, although of course I am far from pretending that amateur mechanics could actually make a watch, I can positively say from experience that, if they would interest themselves more in the subject, they would derive a great amount of pleasure, even from the mere cleaning of a common watch, and the higher branches of the art are naturally more attractive. In England it has hitherto been kept far too much to itself, and the sympathy with its advance which the interest of amateurs would develope could hardly fail to benefit the trade generally. On the Continent its advantage was long ago recognised; thus in 1860, an eloquent article appeared in the *Revue Chronométrique*, from the pen of M. Philippe, of Geneva, "On the necessity for some remedy to arrest the decline of Horology," in which reference was made to this question. He says:—

"If the attention of the public was more frequently directed to our work, if they were more initiated into the difficulties of the art and its scientific aspects, we might succeed in creating a band of amateurs such as formerly existed, such as still exists in all the arts and very many of the sciences . . . . to the advantage of those high-class workers, whose energy and whose talents would often be discouraged without such support."

In the preceding lecture I have referred to the urgent necessity of reform in the tools used in watchmaking; while this primarily had reference to the more extended use of machine tools, it is in a less degree applicable to the smaller instruments used by the maker or repairer. England formerly manufactured her own, but now most of the tools in use are of Swiss construction. And yet Prescot still possesses makers unsurpassed in manual skill by any in Switzerland, and would, doubtless, possess many more, were it not for the fact that the trade was long ago crippled by the underselling of their competitors. They seem to suffer from the same failing as is only too noticeable in other branches of the trade, want of "life," which

is apparently nourished by an unfounded feeling that watchmaking cannot aspire to be a national industry.

This inactivity is, after all, more responsible for the present depression than any deficiency of tools, and, in evidence of this, I would quote the case of Besançon. There, the system of manufacture is essentially the same as ours. The tools employed are similar, machinery being only applied, as at Prescot, to the movement-making. But, while our trade is contracting, theirs is expanding at a remarkable rate. Thus, in the five years 1845-9, the official returns show that the Besançon district completed 239,323 watches, of which 16 per cent. were gold. The out-turn has been steadily increasing since that period, and in one year, 1878, no less than 454,886 were manufactured, nearly double the number given for the above period of five years, and the per-centage of gold cases rose to 32.

Yet, in face of this expansion, which has continued through a period of universal depression in trade, the Besançon manufacturers are keenly alive to the necessity of extending the use of machine-tools. Their success is mainly due to the possession of that essential quality—energy; and they are further supported by the conviction that watchmaking *is* a national industry. I am far from denying that, in this country, there are many keenly alive to the necessity of radical changes; but individual exertion is not sufficient, and no collective action has yet been taken by the manufacturers.

[The lecturer then proceeded to exhibit a number of watches, projecting them on to the screen by the aid of the electric lamp. The collection comprised many varieties of keyless watch, quarter, half-quarter, and minute repeaters, stop-watches, minute and split-seconds chronographs, pedometer and calendar watches, mechanical and musical watches, antique watches, blind man's watch, &c. He expressed his indebtedness to the undermentioned gentlemen and firms, who had kindly lent them for exhibition—Dr. Longton, Southport, for a collection of 24 watches; Messrs. Lund and Blockley; Messrs. Patek, Philippe and Co.; Messrs. Guye; Mr. Glasgow; Herr Von Lohr; Mr. Tripplin.]

And here I must bring this course of lectures to a conclusion. It remains, however, for me to thank most sincerely those many friends whose liberal assistance has enabled me to exhibit these valuable watches, as well as the tools, gauges, and parts of watches at this and the preceding lectures. It is no small privilege to be entrusted with such a collection as that lent me by Dr. Longton, of Southport, and I am sure that his kindness as well as that of others, whose names I have mentioned, will be as much appreciated by you as it is by me. The assistance I have received from various members of the trade has been very great, and if I have been so fortunate as to interest any of my audience in the progress of the art in this country, it has been in great part owing to the specimens and information with which they have always most readily supplied me. And I must not omit to acknowledge the valuable aid I have received from Mr. S. G. Willmott, who has prepared these beautiful diagrams.

Looking back at the ground over which we have gone, I cannot help feeling how many points been either ignored, or barely referred to, tha nevertheless of the highest importance. But that questions of a theoretical or merely descri nature, if discussed with sufficient fulness, w extend over far more than three lectures, and such points as those to which I have drawn at tion are so much in need of consideration, t might count on your indulgence in treatin watchmaking in a manner somewhat different what is generally expected in a Cantor ex It is very seldom that the art is brought b the public at all; and I therefore feel the honoured in being allowed to urge its clai attention in the room of this Society.

There are many reasons why reforms intro into the system of manufacture would now a better chance of being successful. We confidently look forward to the technical in tion of our young watchmakers impr Foreign competition is forcing itself mor more on our notice, and the literature of t has received important additions. If, then of our most prominent horologists at the centres of the industry, would jointly co the many questions that need solutio calliper, the gauges, and the system of facture—and if the several branches of the would cordially work together for the good, we might look with confidence for a improvement in the official returns in t future. The cheaper class of English watch gradually shake off the discredit that se often to hang over it, and might compe some chance of success with those of foreig struction, at any rate, in our own country.

MISCELLANEOUS.

EDUCATION REPORT, 1880.

The report of the Committee of Council on E just issued, has formed the text of a leader in th from which it appears that the following are the chief results. While the schools inspected in 1 only 8,281 in number, in 1880, after but ten y elapsed, they numbered 17,743. In the for accommodation was provided for less than two of children; now there is accommodation f millions and a quarter. The average atten 1870 was 1,152,389; last year it was 2,750, increase of a hundred and fifty per cent. This is not to be set down solely to the Board schools voluntary schools have at least kept pace wi While in the year of the Act there were but 8,28 tary schools inspected, these had increased to 1 1880, the total number of the Board school be only 3,433, and the numbers of children in att in the voluntary schools bearing to those in th schools a proportion of about five to two. The the last inspection showed an improvement not the numbers of children, but in the quality of t done. In the case of "specific" subjects, in w grant depends on the proficiency shown by indi and which are open to children who have the fourth standard, 160,333 offered themselve 476,761 presented in that standard, and of these hundred thousand passed, the favourite subject English, animal physiology, physical geograp household management, or, domestic economy. Taking the large schools with the small, and

: the help given by pupil-teachers, about one ited master or mistress for every hundred n is assumed to be a fair allowance, so that if 00 is to be taken as the full number who ought eceiving elementary instruction in England and the teachers should number about 35,000. The number now existing is 31,422, who are mainly d by the training colleges, such as those at ea and Culham. Mr. Sharpe, the Inspector of leges for Masters, says that the training colleges ot supply the demand for the poorer classes of ; they practically supply the demand for schools can afford to pay about £100 a year for head or t teachers." Out of some 13,000 masters, there 00 who are earning more than £200 a year, with out of 8,000 mistresses there are nearly 390 : the same. More important is the general which is thus stated in the report:—"The salary of a certificated master, which in 1870 5 12s. 9d., is now £127 2s. 7d.; that of a school- was £57 16s. 5d. in 1870, and is now £72 ." About a third of the whole number are 1 with residences rent free. Whereas out of ards established in boroughs, only 21 have compulsory, to meet a deficiency in school odation, in the case of unincorporated towns ral districts no fewer than 1,000 out of Boards have been established by order of partment. The area under "compulsory nce bye-laws" has been steadily increasing, while, in 1872, a population of eight millions that was included, the population subject to ws is now, including that under School Attend- mmittees as well as that under Boards, more enty-two millions. In the voluntary school a sts in London about £2 a year to educate; else- from 30s. to 36s. In the Board school he costs on about 57s.; elsewhere, from 28s. (in Hull) to Bradford). He earns from 15s. to 17s. from ernment grant. He pays from 8s. to 15s. in ence; in the voluntary schools the subscriptions, ke out the expenses, amount to an average of ead, and in the Board schools the amount con- l by rates amount to sums which vary from in Hull to 33s. 7d. per child in London, the being about 15s. Taking the whole amount a elementary education, it appears that the sum ted by voluntary subscribers is almost exactly o that levied by rate—£739,155 as compared 26,226; and that both added together amounts st exactly the total contributed by fees—viz., 828. The total Government grant amounted r to £2,130,009.

OTES ON AMERICAN SCIENCE AND MECHANISM.

W THEORY CONCERNING BOILER EXPLOSIONS.

ablic-spirited individual, Mr. D. T. Lawson, of rg, Pennsylvania, has just succeeded in affording or the solution of a problem that, up to the ; time, is believed to have baffled engineers, viz., se of the bursting of steam-boilers under certain stances. Repeated attempts had been made both Government and private auspices to burst a intentionally with the terrific force known in such tion to spread havoc far and wide, but all such ts had failed, the collapse of a flue having been st that was attained. But an explosion has at been obtained on a scale so grand as to blow the into fragments, which were scattered all over the a which the experiment was made. This boiler ilt of the very best materials expressly for this nd was constructed in the best possible manner. o'clock the fire was started, and at five o'clock hing was ripe for the experiment. The boiler, was six feet in length by thirty inches in diameter, was all that time three-fourths full of water, which was seven or eight inches above the fire-line, and the steam-gauge showed a pressure of 380 pounds to the square inch, the tensile strength of the boiler being 604 pounds to the inch. The spectators having retreated to the bomb-proof sheds erected by the Government, by the agency of a string the valve was pulled, and a full head of steam let into the cylinder. This was attended by an explosion so terrific that the earth shook as if by an earthquake, and when, a few seconds afterwards, the shower of *debris* had somewhat passed, and an examination made, everything was found to have been completely demolished and torn into fragments, some of which were found over half-a-mile away from the scene, others being projected to a greater distance.

The theory that was sought, and is believed by Mr. Lawson to have been established by the experiment narrated, is as follows:—"Superheated water" is the only explosive element in a steam boiler, and when highly superheated, it is as explosive as gunpowder, but it does not explode from the same cause nor in the same manner. Gunpowder explodes by chemical union, upon ignition, the explosion being accompanied by a visible flash. Superheated water explodes, on a sudden reduction of the pressure from its surface, by bursting into steam, which instantly fills over 1,700 times the space occupied by the water. An explosion, therefore, only takes place after the engineer has opened the port and allowed a small portion of the steam to escape into the cylinder, creating a vacuum to that extent over the superheated water, a portion of which instantly bursts into steam, striking every square inch of the boiler with a concussive force many times greater than the regular pressure of steam. The numerous explosions which takes place just as steam is turned into the cylinder at starting are claimed by Mr. Lawson to corroborate his theory.

By suddenly injecting cold water into a boiler of superheated water an explosion will, on the same principles, be caused. The fact of explosions occurring under such circumstances has long been recognised, but in the estimation of many they were supposed to be caused by the cold water coming into contact with the heated iron of the boiler—an hypothesis Mr. Lawson claims is no longer tenable, for viewed in the light of his experiment the cold water would, merely by condensing the steam in the boiler and withdrawing the pressure upon the superheated water, favour the expansion of the latter into steam possessing a greater degree of pressure than any ordinary boiler could stand. Another experiment is soon to be made with a boiler tested under similar conditions, but which it is believed will not burst. In it the means of safety are found in constructing a partition to intervene between the flues and the top of the boiler, thus creating a steam compartment over the water compartment, to be supplied with steam evoked from the water through valves in the partition, and which valves are smaller in the aggregate than the part through which the cylinder is fed from the steam compartment.

The Glasgow readers of this *Journal* will probably recollect of an explosion that took place on board of a new and very quick passage steamer—the *Telegraph*, I think, although I have no means at present of verifying this—over thirty years ago. She stayed at a pier down the Clyde for a short period to land passengers, and no sooner was steam admitted to the cylinders to start her, than the boiler exploded with great violence. Numerous theories were hazarded by scientific men at the time to account for the explosion, that which was considered most tenable being the decomposition of the water or steam into its elementary gases by contact with the red-hot plates of the boiler) which also served to ignite the gases (oxy-hydrogen, thus formed. The new theory of Mr. Lawson as to explosions appears to me to meet this case, and explain it in a more satisfactory manner.

Determination of the Heating Power of the Sun, and of the Colour of its Light.

A party of scientific men have just started upon an expedition of a novel nature. The enterprise has for one of its objects the ascertaining whether the real colour of the sun be not blue, although its main object is to determine by actual experiment the amount of heat given by the sun to the earth. One of the most elevated summits on this Continent in an extremely arid region being essential, the expedition will proceed to the neighbourhood of Southern California or Arizona. It is well known that the chief of the expedition, Prof. S. P. Langley, Director of the Allegheny Observatory, who has acquired a reputation in connection with solar physics, firmly holds that the sun is neither white, yellow, nor red, but of a "deep, dark, beautiful blue," the colour being modified to its usual appearance by its passage through the atmosphere. The value of the inquiry is found in the fact, that if our atmosphere has played the part of an obstructor and modifier of the real colour of solar rays, an enormous proportion of the sun's heat has not been taken into account in those questions of scientific meteorology which have a special bearing on climate.

A Tornado of Unusual Violence.

At almost every hour during these two days are telegrams and letters pouring in, giving an account of one of the most fearful tornadoes which has ever visited the United States, and by which an entire city has been nearly swept out of existence. The force and fury of the storms in the "Far West" are well recognised as matters of frequent occurrence; but nothing, fortunately, for many years, has occurred at all to be compared with that which, three days ago, and in the course of a few minutes, almost obliterated the thriving little city of New Ulm, Minnesota. Many have been killed, a much greater number injured, a still greater number quite ruined, so far as concerns worldly goods. Pending the arrival of the reports from the scientific men and newspaper correspondents, who have started off to visit the scene of this tornado, the few following facts may be accepted as correct:—At twelve minutes to five o'clock in the afternoon of the 15th inst., a dark cloud, which had been seen approaching rapidly from the north-west, engulfed the city, which, at the same instant, was struck by a cyclone that in two minutes had levelled churches and many houses. Total darkness supervened, the noise of the tempest being appalling, especially added to the shrieks of women and the shouts of men, as houses were being thrown down, and their roofs sent flying through the air. After a minute or two a lull ensued, and people began to breathe more freely, when all of a sudden the fated city was struck with greater violence than before by the storm from a nearly opposite direction, and this completed the work of devastation. At two minutes to five the fury of the storm had subsided, but during the ten minutes that it lasted it was shown how active could be the forces of nature. One man describes how, when speaking to his wife, he found himself suddenly being carried through the air a distance of some hundred feet. The head of a well-known young lady, who is believed to have been struck by a piece of timber, was afterwards found on a prairie some distance away, and far from her body. The head of another lady was found at a distance of a tenth of a mile from her body. One child was carried over half a mile, and still lives. Many horses were killed, some having been lifted bodily through the air. Some framed houses have been carried away to such a distance, that no traces of them have yet been found. During the storm the lightnings were playing incessantly, and but for them the city would have been as dark as at midnight, for the fires, which continually were being kindled, could not spring into activity, on account of the torrents of rain. Some little time will have a elapse yet, ere the data are obtained on which to write, in a scientific manner, o this dreadful visitation. New Ulm is owned, a occupied by Germans. The most terrible e history was its destruction during the Indian on the 19th of August, 1862. Since that t grown and prospered, the Indians having b tually defeated. The scientific aspect of the be interesting, as it is so seldom that one of violence occurs in the northern hemisphere.

J

New York, July 18th, 1881.

GENERAL NOTES.

The Telephone in London.—The United Company state that they have now in London 1,000 subscribers, and that the "calls" average It is also announced that the company have ar the Post-office to connect three of their exchan Postal Telegraph Department at St. Martin's-l that messages can be handed to non-subscribers place of business within a short radius of the P a charge of 3d. per twenty words, or they will anywhere in the United Kingdom at the usu telegrams. The list of subscribers to the "Ex cludes the Society of Arts.

Ceylon Pearls.—The Ceylon pearl fisher sign of lanquishing, and a correspondent of *Observer* reports that a new bank has been fishe from which are of a larger size than those hith at this fishery. The prices have run up from £ and if it is found practicable to extend the fishe there is a great probability of the total amoun the Government reaching £75,000, thus exceeding of 1859 (£48,000) and 1863 (£51,017), thoug largest fishery on record, viz., that of 1814, return of £105,000. In spite of the high pric finds are reported to have been disappointing pearl being worth not more than £9. Up to date ment share has netted £48,792.—*Journal of Ap*

Patent-office Fees.—From a return showing a classification of the whole recei Patent-office for the year 1880-81, including s five heads, viz.:—Initial stages; third year year fees; other fees, certificates, sales, &c.; trade marks, the following information is amounts made on petitions for letters patent on applications with complete specifications, £1 to proceed, £20,230; warrants, £18,300; le £18,275; final specifications, £16,625; notices to grant, £82; notices of objection to sealin oppositions, £122; giving a total of £102,819. fees came to £50,300; seventh year fees to £ fees, certificates, sales, &c., to £3,544; and trade marks, £4,982 and £3,784 respectivel £8,766. The total receipts have, therefore, bee

Electrical Meter.—The want of a meter measure the amount of electricity supplied to a sumer is often urged as one of the difficulties to before a system of electric lighting can be widel It is now stated that Mr. Edison has devised a voltaic currents even more ingenious than th meter" which he proposed a year ago to fix in ho with electric lamps. In the new instrument two are suspended in an electrolytic cell containing copper in solution, and placed in a branch cir which a known fraction of the main current is s copper plates are hung upon a lever arm so a when by electrolysis one has grown a certain am (by deposition of copper) and the other grow amount lighter, the lever tips up and reverses through the cell, and at the same time moves a dial-apparatus through one tooth. The action g until the tilting lever is again overbalanced, and when the current is again reversed, and another effected. Each "tip" clearly corresponds to th an exact quantity of electricity through the c registered indications are, therefore, proportional consumption. "But," says *Nature*, "will it w

. OF THE SOCIETY OF ARTS.

No. 1,499. VOL. XXIX.

IDAY, AUGUST 12, 1881.

ions for the Society should be addressed to the Secretary
John-street, Adelphi, London, W.C.

NOTICES.

.T FURNITURE EXHIBITION.

.ibition of Works of Art Applied to in connection with the Exhibition of .t the Royal Albert Hall, is now open ıon-transferable season ticket will be member of the Society on application ›tary.

EDINGS OF THE SOCIETY.

PATENT LAW.

wing memorandum shows the principal n the law which would be made by the Arts' Bill for the Amendment of the r:—

IONERS OF PATENTS.—The Patent-office removed from under the charge of the mmissioners, who are the Lord Chan- Master of the Rolls, and the Law 'hree Commissioners would be appointed of their special knowledge.

TION FOR LETTERS PATENT.—METHOD NG SAME.—The method of application .t would be somewhat as follows:—The would file a Provisional Specification, ld be referred to Examiners appointed pose. They would see that the invention subject-matter for a Patent; that the n fairly described the invention, and ıs generally intelligible and properly hey would not inquire into novelty or ey would report, and their report would › the applicant before being seen by the ners. The applicant would then have nity of conferring with the Examiners 'equired alterations. Provisional Pro- ıld be granted immediately on receipt ication, and would last for nine months. end of that time the applicant would be file a Complete Specification, fully de- s invention. This would be referred to ners, and treated in the same manner as onal Specification. The applicant would to amend his Specification in accordance ecommendation of the Examiners, and ng so, a Patent would be granted. If ners reported that the application was in respect of matters which could not properly be made the subject of a Patent, and if the applicant still persisted, a Patent would still be granted, but the objections of the Examiners would be endorsed upon the Specification.

DURATION OF PATENT.—The duration of Letters Patent would be increased to 17 years—the duration being as now contingent upon the payment of fees at or before the expiration of each period.

FEES.—The fees would be half the present amounts, namely:—

Fee for Provisional Protection . . .	£2	10
Fee for Grant.	10	0
Fee at expiration of fourth year . .	30	0
Fee at expiration of eighth year . .	60	0

EXISTING SYSTEM.—Under the present law there is practically no examination whatever. Applications for Patents are referred to one of the two Law Officers, who reports whether a warrant may be issued for the granting of Letters Patent. The only point upon which the Law Officer decides is whether the invention is proper subject-matter for a Patent, *i.e.*, whether it comes within the definition of the Statute of Monopolies (21 Jac. I., cap. 3) of being "a new manufacture within this Realm." The Complete Specification, upon which the Patent is really granted, is never examined at all by anybody.

SUBJECT-MATTER.—The following is the definition of "subject-matter" adopted in the Bill:—

(*a.*) Any manufacture or any product not being a natural product;

(*b.*) Any machine or any means of producing any manufacture product or result;

(*c.*) Any process or method of producing any manufacture product or result;

(*d.*) Any part of a machine means process or method of producing any manufacture product or result.

At present the ancient definition of the Statute of Monopolies is in force, but, as a matter of fact, the question of subject-matter depends wholly on the decisions of the Courts.

OPPOSITION.—Under the proposed Bill, opposition to the granting of Letters Patent would be limited to persons who could state that the applicant had obtained the invention from them by means of fraud. Under the present law any person can oppose, the general ground of opposition being that the person opposing already has a Patent for the same or nearly the same invention.

AMENDMENT.—The Bill provides that the inventor should be entitled to amend his Specification after it had been first filed. Under the present system this power is very restricted.

PROLONGATION.—It is proposed to continue the system of prolonging Patents in special cases, the Bill being framed in such a manner as to give greater facility for this than now exists. Under the present system, prolongations are granted by the Privy Council, and are considered a matter of special favour, whereas the effect of the new Bill would, it is hoped, be to give them as a right to any inventor who could show just cause for having his privilege prolonged, on the ground of his not having had sufficient reward, or the time having been insufficient to enable him to bring his invention into action, or similar grounds. The period for which a patent could be prolonged

would be diminished by the three years which the Bill would add to its original term.

Obligatory Licenses.—The Bill would compel a Patentee to grant licenses in cases where it could be clearly shown that the invention was not being worked in such a way as to supply the reasonable wants of the public; but the clause has been so worded as to prevent any improper interference with the rights of the Patentee over what is considered to be his own private property.

Trial of Patent Cases.—The Bill would provide for the trial of Patent cases in an entirely new manner. They would be tried, in the first instance, before one of the Commissioners, and an appeal would lie to the whole body. The Commissioners would have power to call in Assessors, and would have such other powers as would enable them to try the cases fully. It is hoped that this would greatly simplify the Patent litigation, and would prevent the enormous expense which is now incurred by having to bring complicated questions of law and fact before a jury, who are probably ignorant of the scientific or mechanical considerations involved. It may be noted that one great source of expense is the preparation of models, which are only necessary to illustrate mechanical questions to persons unaccustomed to deal with such questions. For experts in such matters, drawings would be sufficient; indeed, an engineer would generally much prefer proper drawings to any model of a machine.

Anticipation.—It is proposed that a mere publication more than thirty years old, unaccompanied by use within the thirty years, should not be considered sufficient to invalidate a Patent. The object of this is to remove the hardship which now not infrequently occurs of a Patent being invalidated, or a Patentee being put to great expense in order to prove his claim, by the discovery of some ancient and probably incomplete description, a description which in many cases could not have been put into operation at the time it was made, for want of necessary appliances to carry it into effect.

Patents to Foreigners.—It is proposed that Patents should be granted to foreigners or persons resident abroad, on precisely the same terms as those on which they are granted to British subjects resident in the United Kingdom. At present Patents are granted to British subjects in respect of communications from abroad; that is to say, the theory is, a person travelling abroad sees a useful invention, brings it home, and patents it in England, such person not being, in any sense, the inventor. In practice, Patents for communications from abroad are nearly always taken out by Patent agents, whose clients are resident out of the country, and the Patent, as soon as it is taken out, is assigned to the real foreign inventor. Cases of injustice have occurred through the action of this system, in which a Patent has been granted to a person who had no moral right to it, but who anticipated the original inventor in obtaining the English Patent.

Effect of Foreign Patents on English Patents.—At present an English Patent lapses at the expiration of any foreign Patent taken out by the same inventor for the same invention. It is proposed in the Bill that English Patents should not in any way be affected by foreign Patents.

CANTOR LECTURES.

THE SCIENTIFIC PRINCIPLES IN IN ELECTRIC LIGHTING.

By Professor W. Grylls Adams, I

Lecture I.—Delivered Monday, Mar

The Production and Regulation of Electri —The Laws of the Mutual Induction o and Magnets.

It has been well said, that rarely do discovery, as soon as it is made, at onc furnish the results which follow as a m sequence from it. Nearly all important pass through a stage of neglect or Either the public attention is already pre or the discoveries come at a time when are not prepared for them, and the regarded, and may even disappear authors for a time, to come forward fresh force in after years, when the wo in tune to receive them. Sometimes through a stage of quiet developm laboratory; laws are established, appa vised to prove them, attention is draw public spirit is awakened, and from level of the great discoverer flow nev new inventions, with astonishing rapid channels; the potential energy of the transformed into energy of action in r tions, with more or less efficiency, acco retarding state of the medium through action takes place.

The progress of electrical science in branches will afford abundant instan several stages. If, for instance, we progress of telegraphy, we find that Ronalds, in 1816, showed that electrici practically used for conveying messag distances; yet so little notice is take coveries by the public and by the C who were no longer in need (so they s graphs after the battle of Waterloo almost driven to despair, and speaks leave of a science which once affor favourite source of amusement," and of cordial adieu to electricity."

It is remarkable that he should ha years ago, "Let us have electrical offices communicating with each other kingdom," and yet the electric telegr established until 20 years after (1837) only now arriving at the system o exchanges.

In a private letter, written on his 72 in 1860, he says, "If the electric t 1816 had been fairly examined, an effe ment might have been in the hands of ment, and after Dr. Oersted's experime an improved telegraph might have l hands."

We shall also see other instances i with the special subject of my lectur discoveries are neglected and passed as we say, the discoverers were men advance of their time, and in some ca discoveries are again made, and be under another name. In 1815, Sir Fra constructed an electric engine, whic motion by means of Singer's electric

as 1851 this engine was still in working when it was, I believe, at the Kew observa-

813, *i.e.*, when Ronalds was experimenting e electric telegraph at Hammersmith, by of his registering pith-ball electrometers, umphry Davy produced the electric light be- two carbons, which were joined to the two of a powerful battery.

following is a description of Sir Humphry s experiments with the electric light:—

r. Pepys having had the goodness to charge the battery of the London Institution, consisting of double plates of zinc and copper, with a mixture 68 parts of water, 108 parts of nitrous acid, and rts of sulphuric acid, so as to make an arc or n of electric light, varying in length from one to nches, according to the state of rarefaction of the phere in which it was produced, and a powerful t being presented to this arc or column, having e at a very acute angle to it, the arc or column ttracted or repelled with a rotatory motion, or to revolve, by placing the pole in different ns, being repelled when the negative pole was on ht hand by the north pole of the magnet, and ed by the south pole."

h a few cells of some of the more powerful ies, such as Grove's, or Bunsen's, or the mate of potash battery we may readily re- ce the celebrated experiment of Sir Humphry

n Davy discovered the electric light in little was known of voltaic electricity, ; that the current decomposed salts, and was s accompanied by chemical action in the y. Davy had obtained the metals potassium, n, barium, strontium, calcium, and mag- a by the electric current. The relation be- electricity and magnetism was still un- 1.

he year 1820, Oersted first observed the action rrent of electricity on the magnetic needles, us gave a very ready method of comparing ects of different currents, by balancing these on the needles against the effect of the s horizontal magnetic force. In the same Ampère discovered the law of the action of rrent on the magnetic needles, and pro- led his celebrated theory of magnets and of rial magnetism. According to this theory, particle of a piece of steel which forms the et has currents of electricity circulating round he same direction, and the magnetism of the et is only the resultant action of all these its taken through the whole of the piece of Thus magnetism is the resultant action of c currents.

père's experiments (which were repeated e lecture) showed the mutual attrac- nd repulsion of parallel currents, and of ts and magnets; also that a current in a id or in a flat coil, acts as a magnet; and hollow coil carrying a current attracts a f soft iron and holds it up.

se elementary experiments are now very , and they may be very well known; but, as ll see in the lectures which are to follow, of these early and simple devices are found to nong the most efficient for controlling and ting the current and steadying the light in some of the best electric lamps. Whilst Ampère was developing Oersted's experiment in one direction, Schweigger in the same year (1820) employed it for the comparison of currents, and invented the galvanometer. Then followed improved galvanometers by Becquerel and others; and in 1827, Ohm gave his simple theory of the action of batteries which was deduced from Volta's principle, and this has formed the groundwork of all later investigations of the subject.

If we consider these simple experiments of Oersted and Ampère in their relation to the now well-established principles of conservation of energy, we may arrive at some important conclusions which again are fully borne out by experiment. Thus, when a current of electricity passes along a wire in Oersted's experiment, part of its energy is spent in overcoming the resistance of the wire, and another part is spent in causing the motion of the magnetic needle, *i.e.*, in doing work upon it in opposition to the pull of the magnetic force of the earth upon it. This part of the energy, which is spent in twisting the magnetic needle about the axis, leaves less energy to be spent in producing the current, and so there is less current passing in the wire when the magnet is in the act of being deflected than there is in the same wire when there is no magnet. When the magnet is held at rest, or when it has settled into its position of rest, there is no longer any energy spent in keeping it there, and the full current again passes in the wire. Thus a current which deflects a magnet, is itself diminished by that motion of the magnet. Take again any of the simple experiments of Ampère on the mutual action of currents of electricity upon one another, and the motion of conductors carrying those currents. There is a conversion of energy of the current into motion of the conductor carrying the current in parallel wires attracting one another, and hence there is less current in the wire while the motion is actually taking place. Thus the approach of two wires carrying currents of electricity diminishes the currents flowing in the wires.

Now if the approach of these wires diminishes the currents in them, then the separation of the wires may be expected to increase the currents flowing in them, for in the separation work is done in the opposite direction. Hence, in the alternate approach and separation of the wires as they oscillate, the currents are diminished and increased alternately. If there be no current at all in one of the wires, then the separation of the two wires will give a current in the one which had no current in it, and the approach of the wires will give a current in the opposite direction. Thus we are led, by the well-known principles of energy, to results which are well-known to be true by experiment, that the separation of the parallel wires, one of which is carrying a current of electricity, produces in the other wire a current of electricity in the same direction or a direct current, and their approach produces a current of electricity in the opposite direction, or an inverse current.

Let us pursue this relation of the principles of energy to the effects produced by electric currents a little further. With two parallel currents in two approaching wires, the amount of energy used up, and therefore producing no effect in the shape of current, depends on the amount required or ex-

the velocity of falling, so, in the case of currents of electricity in wires approaching one another, the energy expended is measured by the square of the velocity of approach; so that the alteration in the current takes place more and more rapidly as the rate of approach is increased. If, again, we apply this to the case where one of the wires has a current in it, and a second parallel wire has no current in it as long as it remains at rest, then the amount or strength of the direct current in the second wire will increase at a more and more rapid rate as the velocity of separation of the wires is increased, and the strength of the inverse current in the second wire will increase at a more and more rapid rate as the velocity of approach of the wires is increased.

Here, then, we have the laws of the production of induced currents deduced according to the principles of energy from the relative motion of parallel currents, discovered by Ampère. These laws are of such importance in connection with the subject of these lectures, that I shall illustrate them a little farther by a few simple experiments, showing the effect of rate of approach or separation on the induction current.

Instead of actually removing the coils, if the current in the primary circuit be diminished, the effect is the same as if a wire carrying a part of it had been taken away, and so there is a direct current induced in the secondary wire, whereas, if the current in the primary wire be increased, the effect is the same as if a wire carrying the additional current had approached, and so an inverse current is induced in the secondary wire.

We shall get the greatest rate of separation by suddenly stopping the current in or breaking the primary current, and the greatest rate of approach by suddenly joining or making the current flow in the primary circuit. Hence, breaking the primary circuit produces a very intense rush of electricity, giving a direct current of great intensity in the secondary wire; and making the primary circuit gives a powerful inverse current in the secondary

in A, there was no current induced in B; making contact in A, or on approaching tl there was a momentary inverse current i on breaking contact in A, or on separ wires, there was direct induced current i as this current was of the nature of a wave, like the shock of a Leyden jar, magnetise a steel needle, although it slight effect on a galvanometer, and expectation was confirmed, and that t was magnetised opposite ways on m on breaking contact.

Then, in his evolution of electri magnetism, he gives an account of tl increased effects on introducing soft iron his helices of wire, and shows that similar obtained by using ordinary magnets i a helix carrying a battery current iron core, *i.e.*, in place of an electi Also, in place of a cylinder of iron i of wire, he uses a welded soft iro inches in diameter, and 7-8ths of a thickness, with helices wound round i what would now be called a Gramme remarks that the iron cylinder arrang not so powerful as the ring arrangemen the core within the helix, he magne bringing permanent magnets in conta ends, and observes "a deflection whicl an induced current of electricity in tl direction to that fitted to form a magi the same polarity as that really pr contact with the bar magnets." Such would have converted the cylinder into of the opposite kind to that formed with the poles A and B, and such a cur in the opposite direction to the curre in, Ampère's beautiful theory, are co constituting a magnet in the position fi bringing the bar in contact with the p magnet, a current is induced in the w direction indicated in the figure.

He then describes the experiment of i

the rate of separation of the coil
s of the loadstone, he concludes
s :—" An agent which is conducted
wires in the manner described,
so passing, possesses the peculiar
ns and force of a current of
ich can agitate and convulse the
and which finally can produce a
be electricity."

the discoveries of Faraday, made
ble year 1831, we shall find to be
ance in magneto-electric machines,
nce of time between induction by a
t in a coil and induction by a
requires a considerable interval of
p to its full strength. Faraday
this retardation by supposing that
tribution of the Ampèrian currents
f, so that the magnet requires time
ll power.

. consider for a while the work of
io, fifty years ago, in his first series
e Royal Society, could establish so
nagnetic and current induction, and
ible the rapid development which
n in the science of electricity, and
the production of magneto- and
ines.

ISCELLANEOUS.

N AMERICAN SCIENCE AND MECHANISM.

OMPOSITION OF COMETS' TAILS.

f spectroscopy is known to have made
in the United States, and a few of
justly considered to be entitled to
. subject with authority. Professor
College, has, among others, bestowed
upon the comet, and has just published
lts, and the deductions he makes there-
s that the light emitted by the tail of
arised, rather strongly, in a plane pass-
sun's place. Not only has he fixed the
polarisation, he has also measured its
. his experiments he infers that a large
ight of a comet's tail is reflected sun-
amount being greater than if the re-
il were composed of solid masses, indi-
atter of the tail is in the form of gas or
roscopic examination proves that the
rtly by its own light, and partly by that
he sun. The origin and nature of the
which forms the tail may be inferred
s of recent discoveries concerning the
n comets and meteorites. Former in-
de by Professor Wright indicate that
in large quantities of gas, with a con-
rtion of water, and that at a tempera-
hat of red heat, gas is given off at a rate
over two inches for every cubic inch of
bstance, beside the water vapour. The
e of hydrogen, carbon dioxide, and car-
e two latter in the greater proportion,
arsh gas and nitrogen. Inclosed in a
it low pressure, and made luminous by
lischarge, the meteoric gases give a
h, under suitable conditions, is essen-
s the usual cometary spectrum of bright

THE AMERICAN RAILROAD-CAR VERSUS THE COMPARTMENT CARRIAGES.

The alleged advantages of the American railroad-car over the close compartment system preferred in England is being much discussed here, in consequence of an assassination which lately took place in one of the latter. It may possibly be claimed by those favouring the compartment system, that with such a construction of carriages no such outrage could possibly have taken place as that which is, at this moment, the leading theme in American newspapers. In a part of the country which, Dr. Russell will be telling you, abounds in lawlessness, a railway train left a station, Winston, on the Rock Island and Pacific Railroad, about nine o'clock at night on the 15th inst., when it was boarded at every point by a band of twelve well armed and thoroughly experienced desperadoes. Two jumped on the locomotive, and drove off the engineer and fireman at the revolver's muzzle. Others by similar means prevented the interference of the passengers with their schemes, while the remainder devoted their attention to the safe in which valuable property was contained. There was also some bullion in the form of bricks of silver. Several shots were fired at non-complying or resisting officials, the conductor being killed. No attempt was made to rob the passengers. Now, when the character of the attacking party is considered, it will be seen that such an outrage might have been made not only on a train of compartment carriages, but on one going over even the North London or Metropolitan Railways. The band is composed of old experienced hands, well-known in connection with innumerable deeds of daring, possessed of desperate courage; they have a perfect acquaintance with all the western country between Iowa and the Indian Territory. Their operations are conducted on a large scale, and are almost invariably successful. Their leader is one or the other of the two James brothers, whose mother, now Mrs. Dr. Samuels, is credited with the planning of the outrages so boldly carried into practice by the gang, who must not be compared with the sneaking banditti in Sicily or Greece, as will be seen by the following few examples out of numerous others of a like nature. In 1868, desirous to give a "benefit" to a sick member who wished to go to the seaside, a party of about a dozen, well mounted, dashed into the town of Russellville, Kentucky, during business hours, drew up in front of the bank, and "covered" with their revolvers the townsmen who were passing while two went in and robbed the bank. The following year a similar feat was accomplished in Galanta, Mobile, on which occasion they shot the cashier. Two years afterwards, in 1871, this was repeated, including the shooting of the cashier, in Columbus, Kentucky; and in 1872 a party of six of the gang did the same in Corydon, Iowa. In the same year, and while there were 20,000 people present at the Kansas City Exhibition, they made a successful raid on the cashier's office. They have robbed many banks and the express cars of several trains, and on at least one occasion of the latter nature they impudently sent a telegraphic despatch to the St. Louis newspapers reporting the occurrence before they rode away. Several members have been shot down during hot chases and conflicts with the inhabitants, but no one, even when dying, has ever yet told who his companions were. The recruits are selected from the guerillas of the Southern Confederacy. Many stories are told of their exploits, and these stories, although wonderful, are said to fall short of the reality. Among those who have been shot by them are six detective officers, three of whom belonged to Pinkerton's Detective Agency, New York. Why I have entered at such length on the *personnel* of the gang is this—In the Society of Arts sooner or later the subject of the assimilation of English railway carriages with those of America will be brought forward, and it is more than likely that those unfavourable to the American system will cite the recent robbery as

costs in New York two and a quarter dollars (about nine shillings and fourpence halfpenny) per thousand feet. At present there is no indication that the electric light will be supplied at quite so cheap a rate, although orders are pouring in faster than they can be filled. Now, while many are guided by the novelty and beauty of the new light, and are willing to pay a little more for it, the great majority of the public will be guided by considerations of cost, and will not be readily tempted to incur the expense of fittings for the electric light. By keeping the price of gas so greatly in excess of what the companies admit that it can be sold, these companies are allowing the electric light to obtain a footing from which it may not eventually be easy to dislodge it, more especially if by recent and forthcoming inventions connected with the storage of electricity the prices be reduced, an idea apparently ignored by the gas companies. The more probable theory is that, believing in the ultimate practicability of the electric light, the gas companies will adhere to their present high prices until the electric opposition makes itself too strongly felt, when, all at once, the price to consumers will be reduced to such an extent as will cause the rival bodies to stagger. That this can be done is apparent from the fact that coal is dearer in London than in many places in this neighbourhood; for example, in Philadelphia, where coal is 4s. 2d. cheaper per ton than in London, but where gas costs three times as much as in London. This high price, in the large American cities, arises from there being no competition in the making and supplying of gas as there is in other necessaries or luxuries of life. That a good dividend could be paid at 75 cents. (3s.) per thousand feet is not denied, and the great hope of the public now is, that by improvements in electric lighting, gas may come to be reduced to this price.

New Method of Storing Electricity.

An Ohio electrician, Mr. Charles Brush, of Cleveland, having for several years been engaged in devising means for storing electricity, has now had his labours crowned with success, the means by which he effects this being different from that of M. Faure, which is based on the invention of Planté, several years prior. Brush may or may not have obtained results equal to Faure some years ago, as he claims to have done; what

new "Industrial Encyclopædia" (Spons), is considerable attention among Continental agri and has recently been experimented on with its value as a food for milch cows and fat cat

The beans were first given alone, to test The cattle took them very readily, but to quantity of saliva was required in their m and it was found better to mix them wit food.

First, as to the results with milch cows. divided into two parties. During the first s experiment, when the cows received no fo they gained 1·15 lbs. in weight, and gave of 10¼ pints of milk each per diem. During stage, when the first portion of beans w half the cows, their weight increased by 1·2 milk by ·17 pint, and the cream by 1¼ per other half of the cows, which received gr of beans, grew 1·93 lbs. in weight, and fell of milk each per diem, with no difference centage of cream. In the third stage, th had had beans in the second stage wer grains, with the result that their weight in ·72 lb., and the milk yield fell off 1 pi diem, while the cream increased ½ per other half of the cows, which had had gra on receiving beans, increased 1 lb. in wei milk yield fell off ·61 pint each per diem, a increased by 1¼ per cent. In the fourth sta ing was again reversed. The cows wh grains, on receiving beans, increased ·59 lb 2·34 pints in milk yield, and 2¼ per cent. in per diem; while those which returned fr grains fell off ·66 lb. in weight, and 1·86 p yield, though the cream increased 1¼ per c

The fattening cattle were also divided i During the first stage without fattening increased in weight 72·73 lbs., being ·64 diem; the other only ·11 lb. each per diem. difference was owing to exchanges of th the second stage, the lot which had bea 22 lbs., or ·19 lb. each per diem; those whic instead increased 158·68 lbs., or 1·41 lb diem. During the third stage, the lot rece grew 185 lbs., or 1·65 lbs. each per diem; th beans fell off 39·67 lbs., or ·35 lb. each

s, therefore, the soy bean is superior to r fat cattle, it is less adapted, and ranks rains.

t can be cultivated in Central and Eastern d similar localities, especially in unfavour- , when other crops are backward. For a field crop, it is recommended to be sown in apart in the middle of May.

lities of the beans grown in diluvial and ls are shown by the following analyses:—

	Diluvial.	Alluvial.
....	15·20	13·50
....	16·21	17·94
....	28·63	25·94
genous extractive matter..	30·84	33·16
....	4·38	4·45
atter	4·74	8·82

w or haulm of the plant is practically worth- at cattle, but the husks and leaves, mixed ed food, or even alone, are readily eaten. It en found that the chopped beans, soaked for n water containing a little salt, are greedily attle, and that few pass through undigested.

EXPLOSIVE POWERS OF DUST.

: has been presented on the results of experi- le with samples of dust collected at Seaham n compliance with the request of the Home by Prof. F. A. Abel, C.B., F.R.S., Chemist r Department:—"The results of the experi- n Seaham and other dusts appear (says Mr. have demonstrated—(a) That coal-dust in only much promotes and extends explosions by reason of the rapid inflammability of the ded combustible, and of the readiness with ecomes and remains suspended in air-currents, t it may also be itself readily brought into as a fiercely burning agent which will carry dly as far as its mixture with air extends, perate even as an exploding agent, through m of a proportion of fire-damp in the air of the existence of which, in the absence of the ld not be attended by any danger. (c) That oal-mines, quite apart from any inflamma- ch it may possess, can operate in a distinct as a finely-divided solid, in determining the f mixtures of only small proportions of fire- air, and consequently in developing explosive (d) That a particular dust in a mine may, be a source of danger, even though it con- a small proportion of coal or combustible Although the explosion which may occur he agency even of a non-combustible powder, nner described, may be of very mild or feeble in the first instance, it may be almost at once in magnitude and violence by coal-dust, which nition will raise and bring into action. The n of fire-damp required to bring dust in a operation as a rapidly burning or an exploding en upon a small scale, and with the applica- small source of heat or flame, is below the mount which can be detected in the air of a n by the most experienced observer, with the present in use, as has already been demon- r the experiments of Mr. Galloway. Indeed, s of highly sensitive or dangerous character, se conditions, and very possibly with dusts so than the least sensitive of the Seaham n the presence of a source of considerable heat , such as blown-out shot or an overcharged hole stitute, a small proportion of fire-damp, the pos- ence of which in the mine might not be in the ected, may serve as the inciting cause to the ent of an explosion of coal-dust. In the complete absence of fire-damp, coal-dust exhibits some tendency to become inflamed passing a very large lamp flame at a high velocity; if exposed to the action of a large volume of flame, such as produced by the ex- plosion of freely exposed gunpowder or gun-cotton, it exhibits, in addition, a decided tendency to carry or propagate flame. But, so far as can be determined by experiments on a moderate scale, this tendency is of limited nature, and very different indeed from the property of carrying or propagating flame, which even comparatively non-sensitive dusts possess in the presence of a very small quantity of fire-damp. In con- clusion, it may be admitted as possible that, with the large volume of flame and the great disturbing effect of a blown- out shot as the initiatory cause of the ignition of dust, and its suspension in the surrounding air, such inflammation may, in the complete absence of fire-damp, be propa- gated to a greater distance than the results of small experiments would warrant one in assuming. But it can scarcely be maintained that the air of a mine in which the coal gives off gas at all can be at any time free from fire-damp; and as the existence of very small and unsuspected quantities of that gas in the air of a mine may suffice to bring about the ready propagation of flame by coal-dust, and thus to develop violent explosive effects, it would appear needless to assume that coal-dust may, in the entire absence of fire-damp, give rise to explosions, even of only limited character in coal mines, in order to account for casualties which cannot be ascribed to the existence of accumulations or sudden outbursts of fire-damp."

THE SALT CAVES AND MINES IN THE PERSIAN GULF.

From a recent report by Assistant-Surgeon Abder Rahem, it appears that in that part of the Persian Gulf lying between latitude 26° 10′ and 27° 10′ N. and longitude 53° 50′ and 56° 30′ E., is an extensive area, abounding in a large deposit of salt, which crops out at various places on the earth's surface, rising up into ranges of rocks of no little magnitude. The following are the principal places from which salt is obtained in this area:—Kowin, on Kishm Island, Hormuz, Larak, Pohal, near Khamir, Sir-bu-Nafair, Jabal Bostana, and Hameran, on the Persian coast. The salt-bearing rocks are of a reddish colour, from red ochre, varying from earthy consistence to stony hardness, which covers the salt deposit, and is more or less mixed with it, impart- ing to it a red tint. The ochre is associated, to a small extent, with specular iron ore. The association of the ochre with salt is so constant in the salt area that the existence of the former is almost a sure indication of the presence of the latter. About 16 miles from the Bassidore Station in a south-easterly direction, and three miles from the village of Kowin, on the island of Kishm, is a range of rocks bordering on the sea, and consisting very largely of rock salt covered in some parts by red ochre, while in others large masses of salt of stony hardness and reddish tint compose the surface and mass of this rock, giving it the appearance of a struc- ture made of red bricks and mortar. A salt cave is situated in the western end of the range of rocks, and besides this there are several other places where briny water issues, and collecting in hollow ground close to these rocks, deposits beautiful crystalline masses of salt by spontaneous evaporation. It is stated that some forty years ago, the salt was largely procured by this method; numerous shallow pits were excavated, where, as the brine evaporated, it deposited salt, which was then collected for commercial purposes; but since the natives commenced to quarry the salt, the pits were neglected, as the process was tedious, and the salt ob- tained, little in quantity, and not good in quality for commercial purposes; at the present time, however, the streams of brine and some of the pits still exist, and

The mines which yield the present salt are situated about two miles from the seashore, and the path leading to them winding between the rocks is very difficult for the camels to traverse. The salt is brought on the beach by the camels, costing about 4s. for every "bahar," or ton and a-half, and calculating the customs charges at 1s. 6d., and the cost of quarrying at 5s., the total cost of the salt on the beach would be about 10s. 6d. per ton and a-half. Recently salt of an excellent quality was quarried from the rocks, about 100 yards only from the seashore, thus saving the cost of carriage to the miners. The salt mines at Hameran are also extensive. They are situated about four miles from the seashore, and the salt is found in beds of about 4 ft. thick, with intervening layers of earthy material. The salt beds are hard in consistence, and are broken by means of gunpowder, the masses being subsequently reduced to grannles by wooden and iron mallets. Some of the specimens found were of a pale greenish colour, from an earth of that tint. This earth exists in isolated deposits and mounds, varying from earthy softness to stony hardness, the green tint being produced by the influence of manganese. The quarrying expenses at these mines are about 5s. each ton and a-half, camel hire amounting to about 4s. 6d., and boat hire to Lingah being about 3s. Large quantities of salt are exported by native boats to Muscat, whence it is carried by merchant vessels to Bengal, Zanzibar, Mauritius, Batavia, &c. There is an average annual export of from 25,000 to 30,000 tons of salt from these mines, the best quality coming from the Kishm Island and Sir-bu-Nufair. The price of salt at Lingah varies from 4 to 5 dollars, while at Muscat it is from 5 to 6 dollars per "bahar," or ton and a-half. There are, in addition to these caves and mines, certain springs in the rocks close to the village of Salakh, near Henjam, the waters of which are warm, and charged with salt, yielding naphtha of a reddish colour. It is highly combustible, burning with thick smoke. The natives use it for purposes of light, and also use it locally for rheumatic complaints.

JAPANESE LACQUER AND PAPER.

The manufactures of lacquer and paper, two industries for which the Japanese are deservedly celebrated, were made special objects of study by Sir E. J. Reed

fire. This side of the paper is then appl lacquer to be decorated, and the paper is n pressed upon it by means of a small spatula c The transfer of the pattern from the pa lacquered surface is further assisted b beating the paper down with a small s containing powdered stone. The paper peeled off, and can be used again if desi slight relief of the pattern so produced lacquer is rubbed down with carbon polisl design, and that alone, is then lightly cov thin layer of quickly-drying varnish. Gold, is then applied to the moist surface by a camel-hair pencil if the gold powder be f means of a small tube if it be comparati and heavy. The article is then dried for warm closet, such as is used for drying tl lacquer varnish. The design is next lig with a very thin layer of varnish, appliec of paper steeped in it, and passed very over the object, which is then redried in The object receives further extremely light varnish, and subsequent polishings before plete. Silver is applied in powder in the sa When gold or silver is applied to designs i details of the process vary considerabl application of the metals is effected in subst same manner. When gold and silver are leaf, they are laid upon the varnished surfa for them, and dealt with in the usual n varnish acting as a "size" for the metallic mother-of-pearl is used as an incrustation it is laid on during the varnishing process it be thick than if it be thin, and the final proceeded with until the pearl is brought to

Paper.

Besides the papers made from rags and by European methods, the true Japanese produced from a limited number of materia kinds being *Hishi*, from the *gampi* (*Wickstr cens*) and allied plants, and *Kokushi*, fro *kodzu*, or paper-mulberry (*Broussonetia* which latter is the more important. The t the *kozo* plants for paper-making purposes is a They are cut into 3-feet lengths, and steame boiler containing a little boiling water. T

gummy decoction from the bark of the *nori-noki* (*Hydrangea paniculata*), or from the root of the *tororo* (*Tororo hibiscus*). When the steeping in this mixture has proceeded sufficiently long, the pulp is spread out into sheets by means of fine sieves of bamboo and silk. After draining, the sheets are transferred by means of brushes to drying-boards.

Similar processes are employed for producing paper from the *gampi*. The product is very fine and supple, and admirably suited for taking transfer copies, besides possessing the advantage of not becoming worm-eaten. Paper is also made from the *mitsu-mata* (*Edgworthia papyrifera*).

CEYLON PEARL FISHERY.

The pearl fishery which has just closed in Ceylon has been one of the most successful on record. The pearls procured from the oysters on the banks situated off Silavaturai, on the western coast of that island have been famous from time immemorial for their purity, shape, and colour. In these attributes they far surpass those obtained from the oysters of the Persian Gulf, although they are, as a rule, inferior to the latter in size. The oyster of the Arippu banks is scientifically known as the *Meleagrina margaritifera*, and is of a species not existing on all pearl oyster banks, and of a different genus altogether to that found in the Tamblegan Lake, near Trincomalee, on the eastern coast of the island, which is termed the *Placuna placenta*. The earliest fishery of which we can find any detailed record took place in the year 1796; and from that date the Ceylon Government, up to the year 1874, derived a sum of £1,013,113 from this source. The pearl oyster is curiously migratory in its habits; and from one cause or another the banks are for years together almost totally deserted by them, and long intervals elapsed during which the fishery has from this peculiarity been closed, rendering the return from it quite unreliable as a source of settled revenue. Thus from 1732 to 1746, from 1768 to 1796, and from 1833 to 1854, there were no fisheries at all, and it was feared at the latter date that the oysters had altogether deserted the banks.

A few words descriptive of the system under which the fishery is conducted will be of interest. A report having been received from the inspector that there are sufficient oysters of mature age on the banks, the Government advertises a date for its commencement. A large number of boat-owners, both Ceylonese, and from the opposite coast of India, apply to enrol their boats, and these, probably to the number of 150 to 180, are divided into two fleets, sailing under red and blue flags, which proceed to the banks, situated some six miles from the shore, on alternate days. Each boat provides its own crew and divers, and has on board a guard, whose duty it is to see that the oysters fished are not surreptitiously disposed of. Each diver stands on a flat stone attached to the diving rope, and after taking a long inspiration, closes the nostrils with one hand, and descends on the stone to the bottom, where he hastily collects as many oysters in his basket as the time he is able to remain at the bottom admits of. This varies very much with the capacity of different men; but, in spite of all assertions to the contrary, we believe that few divers can stay below beyond 45 seconds. At a given signal the boats all sail for the shore, and on their arrival they are unloaded under inspection, and the oysters placed in the Government kottoos—palisaded enclosures with a cement floor. Here the oysters are counted, and the proportion due to the boat-owners for their services is made over to them. The remainder, which is the property of the Government, is put up to auction and sold to the highest bidder. The purchasers remove their lots to private kottoos, where the oysters undergo the disagreeable process of rotting, to enable the pearls to be washed out. The stench resulting from this decay is fearful, and it has often happened that the operations have had to be prematurely closed in consequence of the resulting outbreak of cholera. It says much for the careful sanitary arrangements made by the officials in charge that such outbreaks are not of recent occurrence.

The official estimate of the proceeds to be expected from this year's fishing was 400,000rs.; but this estimate has been considerably exceeded, the returns having been 599,333rs. To some considerable extent this increase is due to the improved demand in India for pearls, the competition having been very keen. As yet, official returns have not been published; but the *Ceylon Observer* has kept its readers very fully informed of the results of each day's fishing, and of the prices obtained. The total number of days on which the weather and other conditions allowed of operations being conducted was forty, and the fishing finally closed on April 27. The number of oysters fished during that period is reported to have been about 17,000,000, and the average price realised for them about 34rs. per thousand, though they occasionally brought as high prices as 43rs. per thousand.—*Colonies and India.*

CORRESPONDENCE.

A NEW THEORY CONCERNING BOILER EXPLOSIONS.

Referring to the last paragraph, p. 727, in the *Journal* of the 5th inst., on "A New Theory concerning Boiler Explosions," it is just 40 years since I saw the new high-pressure steamer *Telegraph* leave the Custom House, at Greenock, with a large party on board, for Helensburgh, on the opposite side of the Clyde. Watching her anxiously with a glass, I noticed that she arrived safely at the small quay or landing-place then existing there, but immediately after she was literally blown to pieces by the bursting of the boiler, which was hurled completely over the quay. Many persons were killed, and many more seriously injured.

I mention the occurrence as it may enable any of my brother members who may desire full details to obtain them.

JOHN WM. WOOD,
Collector of Customs.

H.M. Customs, Harwich, Essex.
August 6th, 1881.

TURKISH OFFICIAL STATISTICS.

Two interesting and noteworthy subjects appear in the *Saalnamí*, or Official Almanack in Turkish, of 1296 (1881), a Year Book published at the Ministry of Public Instruction. The one is a statistical account of the exports and imports in Turkey proper for the year 1294 (1878), and the other is a census of the male population of the Empire, as well as the enumeration of dwellings in each Vilayet. The value of the former is particularly enhanced in consequence of the detailed statement of the commercial movement which took place with each country separately with which Turkey stands in commercial relations, and because it is the first work of the kind published by the Government. It will be observed that England figures in these accounts for over $\frac{1}{3}\frac{1}{4}$ of the entire amount.

Bearing in mind too that the general commercial movement, as shown in the following table, cannot be taken as a normal standard of the commerce of this country, 1878 was the year when the Turco-Russian war was terminated; a great part of the Mussulman able male population were kept under arms for two consecutive years, which deprived agriculture of its hands; while some of the richest provinces of the Empire were devastated by the war, locusts, and famine, this must have caused a diminution in the

general exchange of at least one-third. The second part, viz., the census of the population, although incomplete, is yet interesting in so far as it gives an approximate idea what the population of Turkey proper is, or, at all events, what the *Saalnami* assumes it to be.

Without entering into the accuracy of the following items, I will merely confine myself to reproduce the statements of the *Saalnami*.

TABLE I.—STATEMENT OF IMPORTS AND EXPORTS FOR THE YEAR 1294 (1878).

Imports.

Names of Countries.	Value of Merchandise.	Custom-house Duty Levied.
	Piastres.	Piastres.
Spain	2,461	245
England	971,067,606	70,238,401
Austria, Hungary	282,515,715	20,350,786
Italy	56,992,450	3,815,408
Belgium	8,075,290	581,120
America	41,629,333	2,997,209
Persia	54,909,960	8,665,008
Russia	142,390,942	10,259,417
France	325,292,148	23,423,056
Holland	11,007,695	793,026
Greece	31,901,739	2,512,914
Egypt	..	..
Tunis	797,184	57,297
Roumania	62,047,596	3,157,322
Samos	196,950	14,402
Bulgaria	7,768,060	559,299
Sweden	509,465	36,681
Prussia	2,483,399	252,955
Germany	1,328,132	108,334
Servia	6,361	458
Total Piastres	2,000,922,486	147,823,338
Or Lira Turca	20,009,224 86c.	1,478,233 38c.

Exports.

	Piastres.	Piastres.
Spain	252,441	2,272
England	352,177,010	3,172,403
Austria, Hungary	91,975,996	737,778
Italy	14,236,884	128,233
Belgium	6,888	62
America	9,112,633	82,013
Persia	5,255,044	163,380
Russia	34,375,036	310,289
France	256,560,576	2,309,142
Holland	3,351,649	30,165
Greece	32,163,140	306,042
Egypt	48,439,008	3,478,488
Tunis	139,835	10,018
Roumania	563,757	40,029
Bulgaria	348,461	25,057
Sweden	1,888	17
Prussia	390,239	3,513
Total Piastres	839,350,485	10,798,901
Or Lira Turca	8,393,504 85c.	107,989 1c.

Gross total of exportation and importation, Lira Turca 28,402,729 71c.; duties levied, Lira Turca 1,586,222 39c. In ordinary times the external commercial intercourse of Turkey can certainly not be less than £40,000,000.

TABLE II.—STATEMENT OF THE NUMBER O[F] POPULATION AND BUILDINGS.

Names of Vilayets.	Number of Male Population.	Nu[mber of] H[ouses]
Constantinople*	..	6[…]
Broussa	503,033	20[…]
Syria †	382,350	15[…]
Archipelago ‡	146,579	6[…]
Djanik and Trebizond	459,122	18[…]
Angora	342,000	12[…]
Sivas	327,666	124[…]
Aleppo	308,895	130[…]
Adana	170,000	68[…]
Ismid and Bigha (dependency of Constantinople)	125,832	52[…]
Konia	390,098	157[…]
Castamouni	315,111	109[…]
Aidin (Smyrna) §	387,189	191[…]
Diaribekir §	324,843	138[…]
Jerusalem	90,192	29[…]
Yanina	389,251	147[…]
Salonika	452,623	182[…]
Terhala	123,183	49[…]
Monastir §	272,659	105[…]
Cossova §	181,310	59[…]
Adrianople	163,126	134[…]
Erzeroom §	176,850	65[…]
Van §	17,310	5[…]
Bitlis §	49,096	21[…]
Total	6,098,318	2,58[…]

Assuming the male population of Constanti[nople to] be 350,000, and allowing for the incomplete c[ensus of] certain Vilayets, as well as Bagdad, Tripoli in B[arbary,] &c., the entire population of Turkey proper m[ay] likely amount in round numbers to *sixteen* [millions,] including the female sex.

S. STAB,
Cor. Memb. Society [of Arts.]

Constantinople and Smyrna, 27th May, 1881.

GENERAL NOTES.

Commercial Geography.—A letter has [...] appeared in the *Times* from Mr. E. J. Watherst[on advo]cating the establishment in this country of ins[titutions] similar to those working in Germany, under the [name of] "Societies of, or for, Commercial Geography"—"[Verein] für Handelsgeographie." The objects of these [societies] are—first, to give their members information regar[ding the] channels into which the export trade of the country [should] be directed; secondly, to establish agencies in [the] principal commercial towns in the world. This is d[one on] the model of Lloyd's. In like manner as Lloyd's [agents] report concerning ships, shipwrecks, and all matters r[elating] to navigation, to the head quarters in London, so the [German] agents send in reports upon all matters relating to th[e com]mercial rquirements of their districts to the "Centr[alverein] für Handelsgeographie" in Berlin, which reports are [pub]lished in full in the "Geographische Nachrichten," [sold to] non-members for the sum of two marks, or 2s. The [list of] agents includes some of the most eminent German[s] abroad, men of scientific renown, anxious for their co[untry's] welfare.

* No census yet made.
† Exclusive of Hauran.
‡ Some islands not completed yet.
§ Not completed yet.

.L OF THE SOCIETY OF ARTS.

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'RIDAY, AUGUST 19, 1881.

eations for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

ART FURNITURE EXHIBITION.

ixhibition of Works of Art Applied to e, in connection with the Exhibition of s at the Royal Albert Hall, is now open l non-transferable season ticket will be ny member of the Society on application cretary.

EEDINGS OF THE SOCIETY.

CANTOR LECTURES.

IENTIFIC PRINCIPLES INVOLVED IN ELECTRIC LIGHTING.

' Professor W. Grylls Adams, F.R.S.

RE II.—Delivered March 14, 1881.

urement of electric currents.—Efficiency of o- and dynamo-electric machines.—Heating of the current.

the discovery of the principles which I d in the last lecture, and the method of g currents of electricity by the inductive magnets, or currents in motion, the laws currents were being developed; but, for ears after Faraday's discovery in 1831 that en removal of a coil of wire from the pole net gave rise to a current, nothing was done these laws for the purposes of electric Voltaic batteries were being improved, nore constant and more powerful batteries ill, and Grove, and Bunsen were dis- and these were the sources employed to the more powerful currents of electricity. ountry Grove's battery was the favourite; ır laboratories we may say that, up to the time, the 40 or 50 cells of Grove have een used to give us the electric light. used for optical experiments in the labora- source of light should be as steady as and as the carbons burn away, their ould be continually brought to the same ; hence the elaborate arrangements of rk and electro-magnets devised by Staite, and by Foucault, which have reached at perfection in the hands of Duboscq.

One of the carbons, that connected with the positive pole of the battery, burns away twice as fast as the other, and hence the wheel-work must be adapted for feeding these carbons automatically at the proper rate.

When the current flows always in the same direction in the arc, as in this case where Grove's battery is used, and in all cases where the magneto-machine is adapted for producing continuous currents, the positive charcoal point or carbon becomes hollow, and wears away more rapidly; and the negative carbon becomes pointed, and wears away about half as fast.

In the Duboscq lamp, the positions of the points of the carbon are kept as nearly as possible the same; the carbons are moved towards one another by means of a drum carrying two wheels, whose diameters are as two to one, which move two racks, which carry the carbons towards one another. This lamp is far too complicated and delicate in its mechanism to use with magneto-electric machines, and therefore the system adopted in it, for regulating the current and regulating the carbons, requires considerable modification, before this lamp can be adapted for general use for the purposes of electric lighting. It is especially adapted for use with optical apparatus, and for showing by projection on the screen the special characteristics of the arc formed by the glowing gases of various substances. We may use it now for showing the character of the arc formed by silver converted into a glowing gas by the intense heat of the arc. This arc shows us that silver is rich in the violet or chemical rays, and points to the reason why the salts of silver are of so much use in photography.

Electric Regulators or Governors.

By the laws of Ohm we get the relation between the electro-motive force, the current, and the resistance expressed by the statement—

The product of the current by the resistance in a circuit is equal to the electromotive force in that circuit, or $E = C\,(R + r)$.

Regulators may act so as to control—

1. The electromotive force and internal resistance of the battery or dynamo-electric machine.
2. Or they may control the useful resistance in the circuit.
3. Or they may control the external resistance, which does not produce useful work.

Regulators which control the current by altering the electro-motive force or internal resistance of the source of electricity, so as to counterbalance other distributing effects, are not practically of much importance, and so need not detain us long. Suppose, for instance, that an increase of current acted on a rotating governor in such a way as to raise the plates out of the battery, thereby increasing the internal resistance, this would diminish the currents which would so re-act on the governor, and again lower the plates. Or suppose the current passes round a coil which is set with its axis vertical, and that an iron rod supports the carbon and zinc in a bichromate of potash battery, and passes into the axis of the coil, then, as the current increases, the coil draws up the iron core and the battery plates, and increases the internal resistance, which diminishes the current.

Regulators which act on the useful resistance in

diminishes the efficiency of the machine in order to maintain a steady current.

There are many ways of varying the external resistance of a circuit; for instance, a rheostat set in action by clockwork, which is started by an armature of an electro-magnet placed in the circuit. If, for instance, as the current is weakened, the armature of the electro-magnet falls and releases a wheel of a clockwork arrangement, which diminishes the resistance by unwinding the wire of the rheostat. The methods which have been employed have been gradually simplified, and it is found that the simplest means are at the same time the most efficient. For weak currents, Edison's system, whereby a greater or less pressure on powdered carbon increases or diminishes its conductivity, has been employed. Edison also devised a regulator or shunt for the current, by the expanding of a platinum spiral wire placed in the lamp which short-circuited the current on reaching a certain definite temperature. Suppose, for instance, that an arrangement is made by which, when a current increases, part of it is sent through an electro-magnet, which draws up an arm so as to break the direct circuit, and send all the current through the electro-magnet, the resistance of the coil of the electro-magnet reduces the current, the arm falls, and again the current passes through the direct circuit.

Lane-Fox Regulator.

The regulator is an electro-magnet of very high resistance, which takes a branch of the current and acts on one end of a lever. The other end of the lever makes contact with one or other of two pins, which are connected with one or other of two coils forming electro-magnets, called respectively H and K, which govern either the throttlevalve of the steam engine, or which may be made to introduce extra resistance by sliding contact over the wires of a rheostat. When the lever touches one of the pins, a current passes through the lever to the electro-magnet H and turns the arm in one direction, and

necessary to bring the deflections to abo
a shunt of very small resistance, which
a very small part of the current th
galvanometer. Here there is a liabili
in the measurement of the resistance of
The objection to this method is, tha
quantity is measured by the galvano
the error of the observation is multipli
be a thousandfold, or even very mucl
order to arrive at any idea at all o
current flowing in the principal circ
only compare the method to an attempt
the flight of starlings, or of a covey o
measuring or marking, as accurately
the flight of one particular bird whic
separated from the rest, and which is
travel at the same rate, no matter wh
tions or attractive influences may have
its path. At the same time, the di
these measurements are so great that
may be of great service, and this meth
employed by several observers with g

For strong currents, instead of a tan
nometer, Professor Trowbridge, of H
versity, employs a galvanometer in w
carrying the current is capable of tur
horizontal axis, passing through the c
needle. When the coil is vertical, the
is a tangent galvanometer; but on
coil through any angle, the part of
which deflects the needle will be dimini
the current has very little effect in turni
when the coil is near the horizontal po

2. *The Electrometer Method.*—Th
of potential between two points
circuit may be measured dire
by an electrometer like Thomson'
electrometer, or by balancing the e
force between the two points, by a b
same electromotive force, in the circ
a galvanometer is placed, in whi
electro-motive force is found by find

of using Thomson's Electrometer.—potential of the needle, and V_1 V_2 of the quadrants and d the deviation , k being a constant, then

$$k\,(V_1 - V_2)\left(V - \frac{V_1 + V_2}{2}\right)$$

.eedle and one pair of quadrants be

$$\frac{k}{2}\,(V_1 - V_2)^2, \text{ where } V = V_1$$

›viation is proportional to the square ›nce of potential, and is therefore ›f the direction of the current.

›f two electrometers so arranged, the he energy expended between any two circuit may be at once determined. r the case of a continuous current. rometer have its poles attached to two B of the circuit where the potentials V_2, having a resistance r_1 between urrent C, then

$$Cr_1 = V_1 - V_2.$$

wo other points, C and D, in the same ı have a difference of potential V_3 — h have an electromotive force, E, as ›tance r_2 between them, then

$$E + Cr_2 = V_3 - V_4.$$

ıergy expended between these two

$$Cr_2) = \frac{(V_1 - V_2)\,(V_3 - V_4)}{r_1},$$

›flection of the two electrometers will the

$$\text{rpended} = \frac{2}{r_1}\sqrt{\frac{d_1 d_2}{k_1 k_2}}.$$

ımeter gives the current, and the two the work expended.

of a continuous current, we have ›rents succeeding one another at ›h are very short compared with the ation of the needle, then the needle steadily deflected at a deviation pro- the mean value of the square of the potential—

$$d = \frac{k}{2}\,(V_1 - V_2)^2.$$

›e the differences of potential must absolutely at the same instant. This · by placing two contact breakers on ʒ axis of the dynamo machine, so ›t by both of them contact is made ›t the same instant some 20,000 times then the two electrometers will give esults. In place of the electrometer loyed to give the strength of current, ter may be employed, as in Clark's r, in which case, it is only necessary contact breaker, and so the arrange- re easily made.

variation of the current in alternate ines may be obtained by the law of ›he resistance for different periods of for different phases of rotation of the ›er. Thus the different phases of the current may be studied by dividing the period into a certain number of equal parts, and, by means of the contact breaker, making contact only at the same phase of the period of revolution.

The intensity of the light at the different phases of the period may also be studied and measured by means of revolving discs with holes in them, arranged so as to let light through only at the proper instant. The result of experiments is that the law of increase of current in alternate current machines is the law of simple harmonic motion, but the maximum effect does not occur at the normal position, but is displaced in the direction of the motion. Experiments, of which a full account has been given in *La Lumière Electrique*, have shown that even with coils alone there is a retardation of the inductive action arising from the induction of a current on itself. The retardation is about ⅛th of the whole period, even with a bobbin without a soft iron core, and this displacement is independent of the velocity, and rigorously the same for 400, 700, or 1,000 turns in a minute. In the case of magneto-electric machines, there is a retardation which is usually attributed to the retardation of magnetisation of the magnet, but that does not apply to the case of coils, in which case the retardation depends on the self-induction of the current. By the above method, the fall of potential between the carbons in the arc may be measured at different phases of the period of revolution. Thus it is found that at the instant when the circuit is made there is no difference of potential, but in an indefinitely short time the electromotive force rises to 40 or 45 volts, and remains at that value almost without change until the current again becomes very feeble, and then the electromotive force suddenly falls. The difference of potential in the arc seems to be constant within very wide limits for the values of the current. The conclusions arrived at by M. Joubert are that the resistance of the arc is very small; that it varies with temperature and diminishes as the temperature increases. The difference of potential between the two carbons is due to an electromotive force, which is independent of the current, and which is estimated by him at 30 volts. Particles pass between the carbons just as between the electrodes in a voltameter. There seems to be an action like polarisation, and the work done depends only upon, and is proportional to, the quantity of electricity which passes.

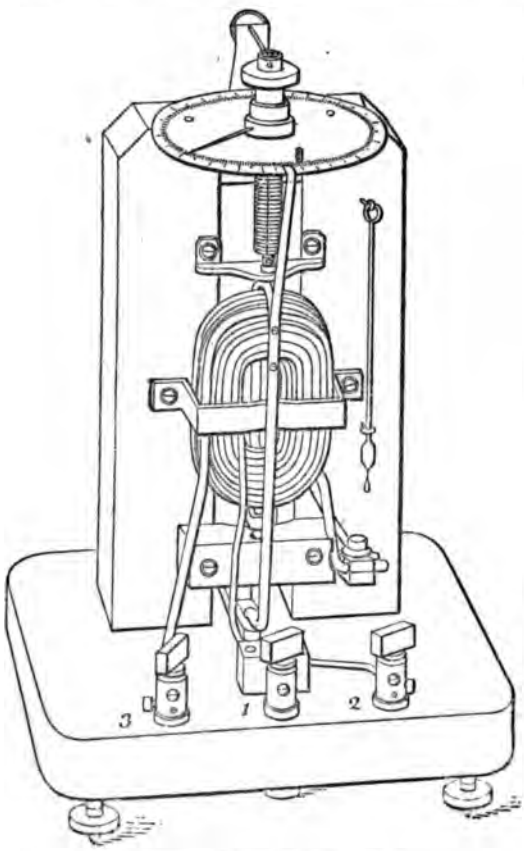
Another method of measuring the currents which is applicable to both continuous currents, and to obtain the average values of alternate currents, depends on the development of heat in an electric circuit. It was shown by Joule, and follows from the law of transformation of energy, that the heat developed by a current C in a resistance r in time t is $C^2 r t$, hence the current C may be measured by the quantity of heat received in a given time by water, in which a resistance r is immersed. This method has been employed by Dr. Siemens, and was one of the methods employed by Dr. Hopkinson in measuring electric light currents.

In his experiments, Joule inserted a wire of known resistance in a given quantity of water placed in a calorimeter, and measured the change of temperature of the water, and also measured the current, and found that $H = C^2 r t$ where H is the quantity of heat produced by the current.

The Electro-Dynamometer Method.—There is still another method of measuring currents, which Maxwell says, "is probably the best fitted for absolute measurements."

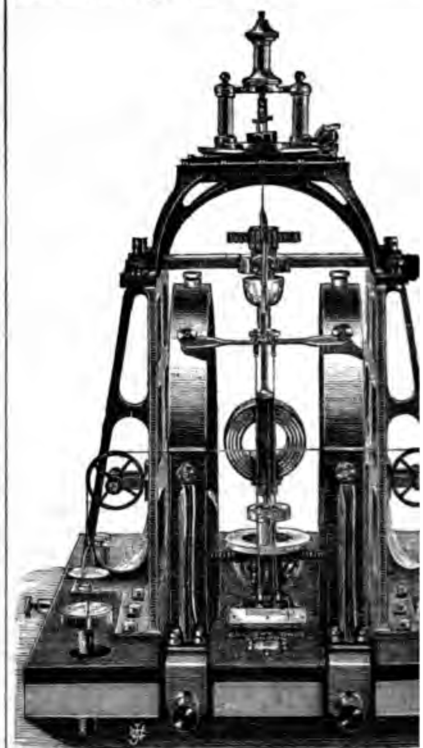
In Weber's electro-dynamometer, one coil is suspended within another, by means of two fine wires, through which the current is led to the suspended coil. This arrangement is not suitable for powerful currents, because shunts become necessary, and because the suspended wires become heated.

An electro-dynamometer on the same principle has been devised by Dr. C. W. Siemens, who has kindly lent me one of his instruments for these lectures.



Siemens's Electro-dynamometer.

Attached to a binding screw (3) is one end of a fixed coil or bobbin, across which a single turn of copper wire with its ends dipping into two mercury cups, is freely suspended in a vertical plane, so as to turn about a vertical axis. One of the mercury cups is electrically connected with the binding screw (1) and the other with one end of the fixed coil, so that between 1 and 3 the same current passes through the fixed coil and suspended wire. When the current passes, the suspended wire tends to turn about a vertical axis, but its motion is counteracted by a torsion spring, to one end of which the wire is attached, the other end being fixed to a socket carrying an index, which must be moved over a graduated circle, so as t[o] suspended wire back to its initial po[sition] action between the currents in the coils fore the torsion which measures it, is to the square of the current. By in[creasing the] number of turns in the fixed coil, and one turn in the suspended wire, the ac[tion of the] earth's magnetism on the current in the wire may be neglected in comparison action of the fixed coil upon it, so that t[he] of the plane of the magnetic meridian at of observation may be disregarded in [the] instrument. There are usually two fixed bobbins; one coil, attached to binding s[crew] being of a small number of turns of thick continuous currents, and the other, att[ached to] binding screw (2), being much longer a[nd] for use with machines giving alternate cu[rrents] currents of high tension.



Hill's Electro-dynamometer.

An electro-dynamometer has also bee[n] by Professor Trowbridge, of Harvard U[niversity] in which there are two large fixed c[oils] from copper bands, between which is from a torsion head a small coil with connections, so that all the current pass[es] each coil. This instrument has been by Mr. W. N. Hill, who limits the the central coil, and measures the c[urrent by] bringing the coil back to its zero by balancing the force of repulsion o[r] by weights placed in two scale pan[s] each side of the instrument, so as the action of the current by torsion of th[e] ing wire. If c be the current, wh[en] th

r the weight w, G, and g the constants coils, and k the constant of the instru-

$$= \frac{l w}{k \mathrm{G} g}$$

e found by measurement, and k is found rison with another instrument. Through ess of Messrs. Elliott Brothers, I have tunity of bringing before you an electro- eter of this form with the latest improve- This form of dynamometer is especially e for large currents, since the weights re- bring the deflection to zero increase as re of the current, and so greater accuracy ttained.

wo blocks illustrating this lecture have been it, that of Siemens's electro-dynamometer by tor of *La Lumière Electrique*, that of Hill's by of the *Electrician*.]

MISCELLANEOUS.

POST-OFFICE REPORT.

nty-seventh annual report of the Postmaster- as just been issued, from which the following s have been taken:—

Letters.

mber of letters delivered in the United during the 12 months was 1,176,423,500, n increase of 4·3 per cent.; the number of , 122,884,000, an increase of 7·4 per cent.; the book packets and circulars, 248,881,600, an f 16·3 per cent.; and the number of news- 33,796,100, an increase of 2·5 per cent. gain a marked increase in registered letters, r recorded being 10,034,546 against 8,739,191 rious year, or an increase of 14·8 per cent.

chinery of the department has necessarily ded; 337 new sub-offices have been opened, e total number of such establishments to hich with 912 head offices, makes the grand st-offices 14,549. About 620 letter-boxes have d, and the number of receptacles of all sorts may be stated at 27,709.

hundred officers have been added to the force, the 31st of December last, had reached a uding all grades, of over 47,000 persons, of r 2,000 are women. The success obtained in women as clerks in the Savings-bank and rer and Accountant-General's Office has led mber being considerably increased. Hitherto s have been appointed upon a plan of limited n, three being nominated to compete for each In future, however, the appointments will through open competition, subject to rules the Civil Service Commissioners. Another extension of the principle of open competition carried out, male and female telegraphists in Edinburgh, and Dublin being now appointed y. The health of the 10,900 officers employed n has been generally good; the death-rate, low, has fallen to a point below any previously the actual number of deaths in London being e rate per 1,000—4·1.

the incidents of the year may be mentioned ns of extraordinary violence, which, impeding mmunication, and severely taxing the energies artment, occasioned large additional expendi- the 18th of January no night mail could be l from London, and on Friday, the 4th of March, five carriages were blocked in the snow in Scotland, and were not extricated till the following Monday, while the Sutherland and Caithness Railway was completely closed for a fortnight. However, during the whole period of the storm not a single mail bag was lost, nor, throughout the year, did any accident occur involving the loss of a life engaged in the postal service. A letter containing a £1,000 cheque, which should have been posted in Lombard-street on the 18th of January, was found on the 24th in the Thames near Deptford, among some snow drift which had evidently been carted from the City and thrown into the river. The letter, which had never passed through the Post-office, was duly returned to the sender. During the Christmas week more than 11½ millions of letters and packets, over and above the ordinary correspondence, and four tons of extra registered letters, representing a total postage of nearly £58,000, passed through the central office. To meet such extraordinary pressure the services of volunteers from other departments of State were obtained after office hours, and the assistance thus procured was found most valuable.

Over 5,300,000 letters were dealt with in the Returned Letter Office, 475,000 of which it was found impossible to deliver or return. One contained a bank-note for £100, still unclaimed; and attached to the seal of another was a sovereign, which was returned to the owner, who had forgotten to remove it. In addition to the letters, about half a million of post-cards, four million of book packets, and 400,000 newspapers found their way to the same office. More than 27,000 letters, an increase of 3,000 over last year, were posted without any address whatever, 5,000 furnished no clue to the sender, and 1,340 contained articles of value to the amount of nearly £5,000. The use of too fragile covers occasioned the escape of some 30,000 articles, and, no doubt, entailed much disappointment. The habit of transmitting animal and perishable matter, such as fish, sausages, birds to be stuffed, clotted cream, fruit, yeast, salads, jellies, live kittens, and dead rats still prevails; and it is necessary to appeal to the public to discontinue a practice so injurious to the health of the officers in one branch of the department, and to repeat the warning that such forbidden articles will be stopped. The return of a letter, posted without an address, to a firm whose direction appeared within, led to the discovery of a systematic robbery of goods and the apprehension of the offenders. At Hull, an incident occurred proving the elasticicity of the postal organisation under heavy pressure. The distribution of nearly 300,000 circulars, weighing 20 tons, issued by a single company, and representing £2,380 worth of postage, was effected without confusion or delay in 48 hours. The despatch necessitated the employment of seven extra railway vans, and it is believed that all the documents duly reached their destination.

Parcel Post.

In October last a Postal Conference, attended by the Secretary of the Department, and Mr. Benthall, one of the Assistant Secretaries, was held in Paris to consider the possibility of establishing an International Parcel Post. After much discussion, an agreement was arrived at providing for the transmission throughout almost the whole of Europe of parcels not exceeding three kilogrammes (about 6½lb.) in weight at very moderate charges. It was, however, impossible for Great Britain to sign the treaty which embodied these conclusions without having previously established for herself an inland parcel post.

Telegraphs.

The telegraph business of the United Kingdom continues to increase; the messages sent were more numerous by 3,419,828 than in the previous year, and the aggregate reached 29,966,965. During the year 107 new offices were opened, and the total number now stands at 5,438. The new main line from London to

had established exchanges, but after much negotiation an agreement was concluded which, while protecting the interests of the public, afforded reasonable advantages to the companies concerned. The system of telephonic intercommunication is, therefore, now being extended partly through the agency of companies and partly by the Post-office. The Department has in course of completion telephone intercommunication systems at Swansea, Glasgow, Greenock, Hull, Manchester to Liverpool, Newport to Cardiff, Leicester, Sunderland, and other towns, and is receiving applications from many quarters.

Savings Banks.

Much has been done during the year to encourage thrift. On the 22nd of November, 1880, an Act came into operation by which any person desiring to invest any sum between £10 and £100 in Government Stock can do so through the agency of a savings bank at a trifling expense, varying from 9d. to 2s. 3d., and have the dividends collected free of further charge. The purchase can be effected either by transferring money from the depositor's account, or by means of a sum specially deposited for immediate investment. Between the 22nd of November and the 31st of March the amount thus transferred through the Post-office Savings Banks was £151,465, and the amount specially deposited. £230,674, making an aggregate of £382,139 invested by about 6,300 persons, and it is satisfactory to notice that the sales did not exceed £7,500. The stock certificates with coupons payable to bearer, obtained under Section 3 of the Act, were, in the period stated, 63 in number, and £4,950 in amount. Notwithstanding the channel thus opened, the total amount of deposits, with the interest due, had, on the 31st of December, reached £33,744,637, showing an increase of £1,732,503 over the amount recorded on the corresponding day of 1879. The Post-office Savings Bank year, prescribed by statute, terminates on the 31st of December, but comparing the financial years ended 31st March, the result obtained is:--The total amount of deposits on the 31st of March, 1880, including interest to previous 31st of December, £32,578,405; the total amount of deposits on the 31st of March, 1881, including interest to previous 31st of December, £34,782,329; esti-

years. The total amount, including depositors on the 31st of December la being £138,500 in excess of the tot year, exclusive of a sum of £17,000 i ment Stock. The names of about 10, were added, and the proportion to 65, as compared with 1 in 74 in 1879. Ireland contributed its quota, and t eight counties scheduled as distre £8,448 over and above the growth of —viz., £33,866 against £25,418.

Postal Orders.

Under the provisions of the "P 1880," a new system was introduc January, providing an inexpensive sending small sums of money to diff United Kingdom. This Act was f introduced in the previous Sessio Manners. Drafts, entitled postal o bought, at any money-order office, for varying from 1s. to 20s., subject to a ing from one halfpenny to twopence. 646,989 of such orders were sold of the producing commission to the amou it is evident, from the increasing public appreciate the convenience The decrease in the number of n sactions, which commenced in 1878, The inland orders recorded show 2·7 per cent. in number, and 2 amount as compared with the pre result is no doubt attributable to the of transmission by other means, s letters and postal orders. The nun large amounts increase, and the for business exhibits a steady progress. the diminution in the number of inlan amount transmitted for the public w sterling, and the losses by fraud an exceed £215. It will be seen that t gross amount, as compared with la made up by the amount of postal ord months, and it may be expected that methods combined will eventually p siderably in excess of the amount for

cent. on the capital, and leave a real 162 towards the cancelling of debt.

observed that, in consequence of the funds being vested in the National Debt , no allusion is made in the accounts to ınd expenditure of the Savings Bank but the Postmaster-General adds the ticulars:—The expense of conducting business during the year was £180,891, than in the previous year. This apparent :penditure at a time when there was a of business was, in a great measure, due t the proportion of the cost of the new uilding in Queen Victoria-street charged 30 was much less than that charged to year. The net profit paid over to the the National Debt Commissioners was would, therefore, appear that the real enditure was £5,629,556, and the revenue 1, showing a profit of £3,071,525.

)LD MINES OF SOUTH INDIA.

ıg is an abstract of a report on this sub- Mervyn Smyth, which was printed at March of the present year:—

h Smyth, speaking of the extent of the ıg region in the Wynaad, says:—"Gold 1 in the South, near Eddacurra; on the Nellacottah; on the West, near Vyteri; East, as far as Bolingbroke, that is to say f more than 500 square miles." (Report :s, p. 61.) Of this area, native workings ıfined to Devalla and its vicinity, a mere ıe country indicated; and even here the no magnitude, the deepest shaft being 70 longest adit 126 feet; and yet it is from s as these, within those narrow limits, we believe that such enormous quantities of following, were obtained:—"B.C. 1000. to Solomon by way of the Red Sea— weight. A.D. 1294. Ransom paid to eneral of Jalalu'a din Khilgy, Emperor of Raja of Deoghar—17,500 lbs. of gold. rt of spoil of Devara Samudra (Halabid, ented by Malik Kafur, to the Em- ılhi—2,400,000 lbs. of gold. A.D. 1309. ıs of Kales Dewar, Rajah of Mabar s of gold, equal to 1,200 millions sterling or s. of gold."—(Gold in India.) That India roduced this enormous quantity of gold obable, as witness the yield of the ines from 1851-68, viz., 147,342,767 pounds what we may well doubt is that all this have been derived from the Wynaad. t which strikes one, and which goes to e Wynaad could not have been the locality ll this gold was obtained, is the singular ns of cities, temples, &c., and the presence forests of vast extent. One would imagine such immense wealth came from, *there* cations of its influence, in the shape of great mples, tanks, cultivation, and other signs ı, be most common, and that such would d result of unprecedented wealth we see n the rapid growth of those marvellous rancisco and Melbourne—that have sprung rness far more desolate than the Wynaad. that suggests itself is, if we are not to look aad as the spot from whence this large old was derived, where else are we to look? t that all the necessary requirements are ı examination of the country forming a great ıose sides may be indicated by the Eastern River Kistna, and the Western Ghauts; and this country was known as Mysore at the death of Hyder Ali in A.D. 1782—a region whose geological aspect is similar to that of the gold-bearing regions of America and Australia. Mr. Eastwick, in an article in the "Gentleman's Magazine" for January, 1880, mentions as one of the facts illustrative of the abundance of gold in Southern India, part of the spoil of Dwarasamudra, amounting to 2,400,000 lbs., presented to the Emperor of Delhi, by Kafur, his successful general. The ruins of this city are to be seen in the vicinity of Halebid, in the Hassan district, Mysore. It is said to have been destroyed shortly after its capture by Kafur by another of the ruthless Mahomedan invaders. The splendid temples still in existence speak of the great wealth of this place. Of the wealth derived from India by Solomon it will be sufficient to say that many of the incidents recounted in the Ramayana, B.C. 1300, show that Mysore was at that time in a flourishing state. Among great cities of more recent date may be mentioned Ikkeri, Shemoga district (A.D. 1640), where gold pagodas and fanams were coined, many of which are still to be seen in the Mysore country, Bednur, or Nagur, at the capture of which place Hyder was said to have obtained twelve millions sterling. Here he established a mint where gold coins—Haidari pagodas —were struck in his name. Vijayanagar (A.D. 1565) identified with Hampe in the Bellary district. Abdul Razzak, who visited it in 1441 as ambassador from the court of Persia, speaking of its wealth, says—"In the king's treasury are chambers with excavations in them filled with molten gold, forming one mass. All the inhabitants of the country, whether high or low, even down to the artificers in the bazaar, wear jewels and gilt ornaments in their ears and around their necks, arms, waists, and fingers." It will be presently shown that all these cities were situated in or near districts known to be auriferous in the present day, and where may be seen ruins of mines of great extent. Of the N. and S. Ponaar (*Pon*—gold, *aar*—river) it will be sufficient to mention the villages of Nulloor and Coondoor, on the former, and Utchalam and Poonpillay, in the Salem district, on the latter, where gold-washing is carried on to the present day. On the western coast gold is found in the Gungavelly and Gairsoppa rivers, N. Canara, and in the Beypore river, in Malabar. The auriferous reefs and old workings of the Wynaad have been reported on by Mr. Brough Smith, while those of Kolar have had more than justice done them by such men as Mr. Munday, Mr. John Harris, Professor Vazie Simon, &c., who have examined them on behalf of different companies. But it is not to these localities alone that auriferous reefs are confined, but scattered all over the whole area are gold-bearing reefs and old mines, some of the latter of far greater extent than any to be found in the Wynaad or Kolar, and it is believed that no spot within the boundaries mentioned can be indicated, which is more than 50 miles from the nearest ancient working. Immediately south of Kolar is Baramahal, in the Madras Presidency, wrested from Tippoo in 1792. The greater portion of this district is made up of low hills, from 1,500 ft. to 4,000 ft. high. In the northern part of this district are the Jaghires of Bagalur, Beriki, Sholagherry, and Kangundi, the mining rights of which have been purchased by several companies. About ten miles west of the Coopum Railway Station is a singular looking conical hill, rising about 600 ft. above the surrounding country, and about 200 ft. above the remainder of the ridge, which runs north and south, for about 15 miles. The top of this peak terminates in a boss, which overhangs on its S.W. side and gives it a conspicuous appearance, so that it can be recognised from miles off. This hill is known as Mallapakondah, and is situated in the Kangundi Jaghire, Salem district. Half-way up this hill, and on its southern face, is the entrance of an adit driven into the heart of the hill. It would appear that there were originally several of these drives at different levels, and the topmost is now filled in with

allowed of so expensive a pathway being constructed. The quartz is highly ferruginous and dark coloured, dense in centre and cavernous where it joins the casing —the latter a kind of vitrified slate. The principal reef is about 10 ft. wide, and on either side are smaller reefs, from 2 ft. to 2 in. Sulphate of iron is apparent in some of these, and it is not difficult to collect flowers of sulphur in small quantities. No gold can be seen in the quartz by means of the naked eye, but a small piece of a few ounces, crushed and washed, gives innumerable grains of fine gold. It is not necessary to choose a particular piece of quartz; any bit from the *débris* lying about may be tested with good results. Two miles south, and on the same ridge, are two other mines within half a mile of each other. The more northern, called "Goolgunta," consists of three circular shafts sunk at the angles of a triangle, whose side is 50 ft. The shafts are connected by passages at about 40 ft. from surface, but it is impossible to tell their extreme depth, owing to the large quantities of water in them. Great heaps of *débris* testify to the amount of material that must have been excavated. Half a mile S.E. is the "Chigarulgunta" mine, the entrance to which is by means of two shafts, each about 7 ft. wide and 20 ft. long. The upper shaft is about 60 ft. deep, and at one end is a narrow man-hole (just large enough for a small man to wriggle through), leading into the adjoining shaft, which is fully a 100 ft. from surface. At the bottom of the deeper shaft are two adits, running N.W. and S.E. along the strike of the reef. Great numbers of rock pigeon have taken up their abode in these mines, and eggs innumerable and young pigeons are seen in the clefts of the rock. The great heap of excreta of these birds (not less than 20 ft. in height) testify to the age of these mines. The whole of the rocks below are coated with chloride of ammonia (sal ammoniac) from the urine of the pigeons. The quartz is of a yellowish white colour, and pyritous, and is extremely hard, as is the casing, and it is wonderful to think how the natives could have cut through such dense stuff with their primitive appliances. One sample containing visible gold was chipped off from a leader 100 ft. from surface. Two miles further south is another large mine called "Nundymoduk" or "Baswana." The natives say that this mine is of great extent, but the water with

of fortifications are to be seen, one
the top of the hill. Within the topm
tion is a large cave running some dis
of the hill; and within this cave, t
mint of Ballala Raj was constructed.
say, when after heavy rain, wat
mouth of the cave, small gold coi
picked up. This locality, with its nu
affords ample materials for the arc
miles south from this place, we c
worked by Tippoo, in the Kolegal
district. These mines, as well as th
Taluq of Chamrajnuggar, Mysore
filled in, it is said, by Tippoo, and
the neighbouring villages deported,
gence of these workings reaching
English, under Lord Cornwallis, w
from this direction. The mines i
are of great extent and of much
is from this region that all the g
common at Munipur is supposed
Land for mining purposes in Ch
Kollegal has been applied for, by s
Indian Companies. Thirty miles t
come to the Neilgherries, where the
of some extent at Nunjanaud, descri
Smyth in his report on the Wynaad.
have the gold fields of the Wyna
Skirting North Wynaad is the Hegg
Mysore Territory, where gold is s
the streams. ("Mysore Gazetteer,
Still further north, in the Attikup
the gold field of Chinnataghery, nea
mines are reputed to have been of g
have been worked out. The famous
—the richest in Mysore—is said to h
the wealth derived from these mine
few washers are just able to earn a p
by sifting the sands of the nei
during the monsoon. The late Ma
made an attempt to work these fie
set of native miners for about a mon
were obtained, the attempt was a
twelve years ago several samples
this locality by Col. Hill, of the M
with a request that they might be

nation of the low slate hills to the west of iid, and so far north as Sakarapatam will show, they are in some places actually honey-combed mines, some in good preservation, others filled in *débris*. Every stream about these hills gives a yield of gold, showing that their auriferous h is far from exhausted. In the adjoining Taluq rnhalli, are numerous mines and old workings, common was this metal during the reign of the ala Ballala kings, that a local tradition has it that ulptors employed on the famous Halebid temple, paid in gold equal in quantity to the dust resulting the tooling of those "marvellous elaborations of iental sculpture." There may be some truth in radition, as even the price alleged to be paid to asons would not be too much for work that has forth the following eulogium:—"Some of these arved (on stone) with a minute elaboration of which can only be reproduced by photography, may probably be considered as one of the most illous exhibitions of human labour to be found, in the patient East." ("Fergusson's Architec- 'p. 397.) These temples are computed to have iine millions sterling. Seventy miles due west Halebid, and in the South Kanara District, ave the celebrated diggings of Moondabetta, miles south of Mudu Badari. Here, too, ean enterprise has stepped in, and after one ro failures is now in a fair way of success. i-east from this we have the Honnali fields in the oga District. Of the richness of these fields we udge from the following official communication Mr. W. Hill, Deputy Commissioner of the Shemoga ct, to the Commissioner of the Nagar Division, respectively Novmber 16 and December 16, 1878:— only place in the district where gold is to be found Nulla near the village of Pulvanhulle in the anhulle margin of the Honnali Taluq. It appears gold dust was formerly obtained by washing the of the nulla. The right to do so used to be farmed ider the head 'Julgar,' but this item of revenue abolished in 1870. *Vide* Isthiar, dated 28th mber, 1860, the amount of contract realised was— 58, Rs. 357 8 a.; 1858-59, Rs. 264. Since then Rs. weight is brought weekly to the market at iti for sale by the julgars (sifters)." "Since ig my letter, No. 763, of the 16th ultimo, on the washed out from the sand, or rather alluvium, of alavanhulli stream, three miles south of Nyamti, e the honour to report that I have been able to the spot and gather the following further par- irs:—(2.) The number of men who gain a liveli- by washing the gold is about 20. Their number formerly greater, but several have been attracted ig the last ten years to a hill called Bijari Gudda, Karkal in South Kanara, where the finds are said greater and the work more remunerative. Work ried on in Pulvanhulli mostly in the rainy months, regular workers are said to be able to earn as much s. 50 in the season. Once and again small nuggets iet with. The largest found was about ten years 1 oz. 14 dwts. 6 grs. in weight; another, more itly, of 1 oz. 5 dwts. 17 grs.; and a third, acci- illy to an outsider, of 1 oz. 1 dwt. 10 grs. in weight. quantity of gold bought annually in Nyamti and eighbourhood is said by the traders to be 1 lb. 11 oz. eight, of the value of Rs. 800. I beg to forward iall specimen of the gold, valued at Rs. 5 be obligingly returned if not bought for the ium), also some black ferruginous sand with minute cles of gold (of the value of As. 3), such as lly found by the washers. The process followed iem is very simple. They dig up the loose gravel vium) in the bed and sides of the stream, and ng a quantity of it in a small trough, on a slight ie, wash the earth out about three or four times, ast the heavy stones away, till only the light black sand remains. This they put into a hollow, flat, round, wooden dish, sift it, if the particles of gold are visible, after which they gather them together with the use of mercury, which, being volatile, is afterwards easily separated. The diggings are not confined to the Palvanhulli stream, but to all the minor streams flowing from the hills in the neighbourhood. One of the best is said to be the Surhona stream, near Devikopa, a little off the Kumsi Honali road, about three miles N.W. of Nyamti, and about the same distance from Palvanhulli. The chief drawback to its being worked is the want of water. The Jalagars (washers) informed me that they were well aware that gold was dug up from pits in Kanara, but they explained that it would be useless to attempt it here, as veins of gold were not found embedded in the quartz. I forward specimens of the quartz, slatey rock, gravel, and hematite (iron stone) picked up by me at the heads of the streams from which the gold is washed down. They may be of assistance in enabling Mr. Brough Smyth, with the foregoing information, to judge whether it would be worth while to take the trouble of inspecting the locality. Evidently the prospects of finding richer veins in South Kanara are greater." It is a noticeable fact in Indian polity, that where a handicraft has been confined to a family, or set of families, for a lengthened period, the people who practice the calling are identified with it, and it becomes a caste distinction, as much as the well-known four great divisions of Brahmin, Kchetria, Veishya, and Sudra. The goldsmith is as much distinguished from the weaver as the Veishya from the Sudra, while the barber and shoemaker have but little in common beside their humanity. Now, in Mysore, we have the well-known caste of julgars (gold washers), not very numerous at present, perhaps, yet so well known that the commonest ryot can tell whom you want when you ask for a julgar, thus showing how common the calling must have been at one time. They are to be found in some numbers in the vicinity of known auriferous localities throughout Mysore, and their presence is, in a measure, indicative of the richness of the reefs there found. One other fact which goes far to prove that gold was commonly found in the country, is to be seen in the geographical nomenclature of the province. Scattered all over this area are rivers, hills, towns, villages, and even whole districts, whose names are made up of a prefix, meaning gold, and a distinguishing terminal. It is not to be expected that so important a mineral as gold would have escaped the attention of the various races who have at different periods conquered the country; and that it did not may be learnt from the fact that we have Sanscrit, Tamil, and Kanada expressions, meaning gold, to designate places from whence this mineral was obtained. Thus the Sanscrit for gold is *suvarna* and *hemma*. So we have the rivers Survana-mukhi (gold-face) in the Kolar district, and Survana-vati (gold-feature) in Chamrajnuggar, and the village of Survana in the Honali taluq. Shemoga; Hemavati, a tributary of the Cavery, and Hemagiri (gold-hill), a large bund across this river in the Narsipur Taluq. In Kanada, gold is *Honna* and *Chinna*, and we have Honnu-Hole, Honnali, Honnavalli Honni Kambli, Bhatta, Honavar, and Chinnagherri. In Tamil we have Ponaar, Ponoor—*pon* being Tamil for gold.

PUBLIC INSTRUCTION IN THE PROVINCE OF BOLOGNA.

Consul Colnaghi states that the law of compulsory instruction passed by the Italian Parliament in July, 1877, has with satisfactory results been put in force in the commune of Bologna, where nearly the full complement of children required by law to be under instruction are present at the schools, with the exception of the mountain and country districts, where material

has been introduced in the schools of the commune of Bologna as well as in those of Imola, San Giovanni in Persiceto, S. Georgio di Piana and other districts. Elementary gymnastic movements performed in school time on the benches are carried out in all the schools of the province. The number of schools in the province of Bologna in the year 1878-9 was 45, in addition to which there were 215 public evening schools for adult males, and 192 public fête day schools for adult females. Of the masters engaged in teaching at the evening schools, 6 are ecclesiastics, and 209 laymen, 210 hold permanent, and 5 provisional diplomas. Of the mistresses of the fête day-schools, 183 are provided with permanent, and 9 with provisional diplomas. The evening schools are open only during the winter months, the fête day schools during the whole year. In addition to the municipal grant there is a Government subsidy of 16,350 lire to be divided among the 407 teachers in the proportion determined by the provincial scholastic council. For secondary classical instruction the city of Bologna possesses a royal Lyceum with 101 scholars, a communal gymnasium with 235, an archipiscopal seminary (lyceum and gymnasium) with 93, a private lyceum and gymnasium with 91, and two other private gymnasia, one with 76 and the other with five scholars. The city of Imola contains a communal school with 54 boarders and "externes," and an episcopal seminary with 24 scholars. Secondary technical education is given in two communal technical schools, one divided into two sections at Bologna with 330 inscribed scholars, and the second at Imola with 63. Bologna maintains an upper female school with 76 pupils, 30 in the preparatory class and 46 at the school. There are two Government normal schools for the instruction of masters and mistresses for the elementary schools; they are provided with 22 teachers, and are attended by an average of about 200 students. For higher education the celebrated University of Bologna still flourishes, and maintains a good reputation by the assistance of distinguished professors; it contains four faculties—jurisprudence, medicine and surgery, mathematical and physical sciences (to which a school of application for civil engineers, maintained in part by the Government and partly by the municipality, province, and other institutions has been added), and philosophy and letters, with various minor classes, and is frequented by about 500 students. The Royal Technical Institute, estab-

period half was to be devoted pa
ment of a school attached to the l
teaching mathematics applied to
to reward any inventions that migh
in connection with art, industry, c
other half is to be placed at com
another period of thirty-one yea
division is again to be gone throug
of the property will take place this
lire will be available for the pur
1911, the amount to be divided wil
1941, 1,435,902 lire, and so in a c
ratio. If the commune of Imola
the wishes of the testator, the le
commune of Bologna.

GENERAL NO

International Medical and S
1881.—This Exhibition, organised by
Parkes Museum, was closed on Sat
when the number of visitors, exclu
holders, was 1,221, making a total of
four weeks during which the Exhib
allowing for one visit only by each
The closing of the Exhibition was t
the St. John Ambulance Association,
tion of ambulance practice, and durin
number of the visitors assembled i
witness the practice. Prizes were com
the Grenadier Guards, the Finsbury
politan Police. It is expected that the
awarded to exhibitors will be distribute
of the Parkes Museum in the autumn.
design for the diploma was entrusted
who has produced a composition, in t
female figure, representing Sanitary
a boat, in the act of casting out a life-

Electric Lighting.—The station
now lighted by the Crompton electric
Crompton lamps within the station,
platform, and six above the departure
of a larger size are placed on the outs
the extreme corners of its front. Th
from five Burgin dynamo-electric
steam-engine of 12-horse power nom

OF THE SOCIETY OF ARTS.

No. 1,501. VOL. XXIX.

DAY, AUGUST 26, 1881.

for the Society should be addressed to the Secretary
-street, Adelphi, London, W.C.

NOTICES.

FURNITURE EXHIBITION.

ition of Works of Art Applied to connection with the Exhibition of the Royal Albert Hall, is now open 1-transferable season ticket will be ember of the Society on application ry.

DINGS OF THE SOCIETY.

CANTOR LECTURES.

TIFIC PRINCIPLES INVOLVED ELECTRIC LIGHTING.

fessor W. Grylls Adams, F.R.S.

E III.—DELIVERED MONDAY, MARCH 21, 1881.

to- and dynamo-electric machines for ing.—Electric lighting by means of the

iental principles which underlie all tric machines are the four great prin- red by Oersted, in 1819, by Ampère . 1820, and by Faraday, in 1831. In discovered the action of a current on a magnet. In 1820, Ampère dis- ction of magnets and currents on ctricity in their neighbourhood, and ear Arago showed that currents of duced magnetisation, thus laying the f electro-magnetism; and in 1831 ed that induced currents were pro- motion of magnets. All machines ersion of work into electricity are araday's great discovery of the in- , derived from the relative motion of a coil of wire.

ectric machines are divided into two according as they furnish continuous ternate currents. All such machines as far as regards the currents in the e currents are made to flow always in ction in the external circuit, in con- it machines, by means of a commu- verses the contact at every half-turn.

The machines of Pixii, in 1832, followed by those of Saxton and Clarke, were the first continuous current machines. From these we may pass to Wheatstone's introduction, in 1845, of electro-magnets in place of permanent magnets, to produce the magnetic field. In 1854, Messrs. Werner Siemens and Halske introduced the Siemens armature, in which the coil is wound longitudinally in a groove. The strength of the continuous current depends on the velocity of rotation, on the length of the wire, and on the power of the magnetic field formed by the magnets.

It is remarkable that, in 1854, Hjorth originated an idea which was some 13 years in advance of his time; he patented an improved magneto-electric battery, in which the currents induced in the revolving armature pass round the electro-magnets, and increase their magnetism, and so increase the induced currents at compound interest rate. This was the celebrated principle afterwards re-discovered by Siemens and by Wheatstone simultaneously in 1867, which has formed the basis of all dynamo-electric machines, and which, for equal power, are cheaper and more compact than all other magneto-electric machines.

DYNAMO-ELECTRIC MACHINES.

In February, 1867, Dr. Siemens and Sir Charles Wheatstone, on the same evening, presented to the Royal Society their two papers, "On the augmentation of the power of a magnet by the reaction thereon of currents induced by the magnet itself." According to the principle then put forward by Dr. Siemens, the rotating armature, the electro-magnet, and the external resistance, such as an electric lamp, are joined up so as to form one simple circuit. A small amount of magnetism is communicated to the electro-magnet, so that, on rotating the coil, a current is induced alternately in opposite directions, and after being reduced to the same direction by a commutator, this current passes through the coils of the electro-magnet in such a direction as to make it stronger, so enabling it to react on the armature. Thus the magnet and the armature act and react on one another, strengthening the magnetic field, and continually strengthening the induced currents. Sir Charles Wheatstone put forward the same principle, and called attention to the fact that at the first instant of completing the combined circuit the effects are stronger than they are permanently. The principle of these dynamo-

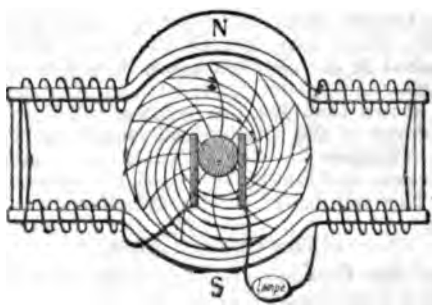


FIG. A.—DYNAMO-ELECTRIC MACHINE.

electric machines is clearly shown in the figure A, where N and S represent the poles of the electro-

magnet enclosing the revolving armature, the external resistance in the circuit being represented by an electric lamp. Sir Charles Wheatstone also pointed out that a very remarkable increase of all the effects is observed, when a shunt is employed to divert a great portion of the current from the electro-magnet. By that means four inches of platinum wire, ·0067 in. diameter, was made to glow. A certain resistance in the shunt was found to be necessary to produce the best effects, so as neither to weaken the magnetism too much, nor to give the current too much work to do in heating a high resistance.

In addition to this, Sir Charles Wheatstone showed that the effects above described are far inferior to the effects obtained by placing the work to be done in the shunt circuit. Thus seven inches of wire were made to glow in the shunt, when only four inches of the same wire would glow in the original circuit. There is thus a double advantage, for there is no loss of resistance by introducing the shunt, the resistance of the shunt being the resistance on which the useful work is done.

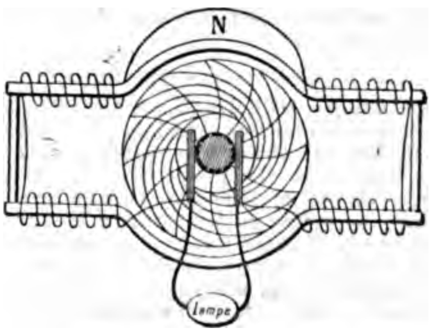


FIG. B.—DYNAMO-ELECTRIC MACHINE.

This improvement, suggested by Sir Charles Wheatstone in 1854, and now being adopted by Dr. C. W. Siemens in his latest dynamo-electric machines, is very well shown in figure B, for which, as well as for the other figures illustrating this lecture, I am indebted to the kindness of the Director of *La Lumière Electrique*.

Wheatstone also showed that the effects are much less influenced by a resistance in the electro-magnet branch than in either of the other branches. Thus, with about four inches of glowing platinum wire in circuit, the addition of about five inches of platinum wire in the armature branch, or in the shunt, produced a ¾-inch glow, whilst four feet of the same wire was required in the electro-magnet branch to reduce the glow to three-fourths of an inch. Dr. Siemens has shown that, for the greatest efficiency, the resistance of the rotating coil must be small, but the resistance of the electro-magnet may be increased, and that in both cases the wires should not be small, but of considerable diameter.

THE GRAMME RING.

In the Gramme armature, coils of wire are wound in sections, all in the same direction, round a ring; and each section, when a current is flowing through it, may be regarded as an electro-magnet. The similar poles of all these sectional electro-magnets will point in the same directi the ring. Consider only one of thes magnets with its north pole directed to south pole of another magnet, it will be towards it, and with greater and greater nearer it approaches; on passing the so its own south pole will be presented to pole of the fixed magnet which it has ju and its motion will be continued in direction.

Now, suppose no current to be flowi ring, then, on applying force to produce motion as before, the induced current the opposite direction, *i.e.*, as the coi towards the south pole and past it, th current in the coil is round the ring, as it from behind, in the direction oppo motion of the hands of a watch.

With right-handed winding of the ring like a cork-screw, the current towards the observer, or in the opposit to the motion of the ring on the side south pole.

If we consider a section of the rin proaches and goes away from the north magnet, the induced current in the observer looks at it from behind, wil same direction as the hands of a wat that the current will be away from the in the same direction as the motion of the side nearest the north pole. Hen flow opposite ways round the ring halves of the ring, and meet at points from the two poles.

DYNAMO-ELECTRIC MACHINE

When the armature of a dynamo turned, the amount of work which is means of it is proportional to the numb the armature per minute. If the same cu through the electro-magnet and the arm the current in one acting on the cu other will attract or repel it with a fo tional to the product of two currents, square of the current. The action currents is increased four-fold, when in each is doubled. Hence, when such used as a generator of an electric c external work which can be done by t in the electric arc or elsewhere is pro the square of the current.

USE OF SEPARATE EXCITING MA

In all dynamo-electric machines, whe current passes round the magnet and th any disturbance in the resistance of circuit, in the electric arc for instanc alters the current, and this alters the the magnetic field, which again produce disturbance in the current, so that any is intensified, just as the permanent ma the iron core is intensified by the act current in the machine on itself.

To obtain greater regularity, Wild proposed to employ a separate continuo machine to give a permanent magneti to revolve the armature of the secon between the poles of the magnet which by the first machine. In order to find t effective work of these machines, and thei

ctric lighting or for other purposes, we have from the laws of Ohm and Joule, that rements of current, and of the work done by rent, must be made.

he last lecture I indicated four methods of such measurements, viz. :—

he galvanometer method,

he heat method, *i.e.*, by the change of ature produced by the current in a wire of resistance.

he electrometer or potentiometer method.

he electro-dynamometer method, *i.e.*, by the ion between different parts of the same t.

FICIENCY OF MAGNETIC AND MAGNETO-ELECTRIC MACHINES.

e take a battery in a closed circuit, we know, he laws of Faraday, that the amount of t produced is directly proportional to the s of the chemical elements decomposed in f the cells of the battery, the quantity of solved in the battery being a measure of the y of current which has passed. According laws of transformation of energy, the work the chemical actions is here equivalent to rk done in heating the circuit. We may the energy or the work done by electric s in the same way as we express the energy d of water by the pressure multiplied by y of water. The electro-motive force corres-o pressure, and the current flowing to the y of water, so that the work done by the is the product of electro-motive force by ntity of electricity.

vork which can be done in the circuit is where E_0 is the electro-motive force of the , and this is spent in heating the resistance. $E_0\ C_0 = C_0^2\ R$, where C_0 is the current d through a resistance R. Now, if any of the circuit, carrying a current, be set in under the action of exterior magnetic or under the influence of the mutual re-of the currents in the fixed and movable hen the equivalent to the chemical actions battery will be spent in producing the of the conductor, and partly in doing the f the electro-dynamic or magnetic forces. enting the work done in producing motion nd the current in this case by C, we get $= C^2\ R + K$. The work K is equivalent to ernal work done by the current C. Now, ternal work K gives rise to an opposing -motive force in the induced circuit, and the of this induced current is $E\ C = K$: or is the electro-motive force due to induc-

efficiency of an induction machine, when s a motor, is the ratio of the work K to the ork $K + C^2\ R$, *i.e.*, the ratio of the electro-force of induction to the total electro-force of the battery. The efficiency

$$\rho = \frac{E}{E_0} = \frac{K}{K + C^2\ R} = \frac{1}{1 + \frac{C^2\ R}{K.}}$$

effective work $K = E\ C$ and $C\ R = E_0 - E$.

ore, $K = \frac{E. (E_0 - E)}{R}$.

If, then, a battery of electro-motive force E_0 be employed, and an induction machine be employed as a motor, then the effective work depends on the product of two quantities, one of which increases as fast as the other diminishes.

Now, if one quantity increases as fast as another diminishes, their product is greatest when the two are equal. Hence such a machine is most effective when $E = E_0 - E$, *i.e.*, when $E = \frac{1}{2} E_0$, so that $K = C^2 R$ and $\rho = \frac{1}{2}$.

Half the work of the battery is then spent in heating the circuit, and the other half in doing the external work. This corresponds to the case where the strength of the battery current is diminished by one-half through the effects of induction. If the same machine be employed to produce a current of electricity by applying external work to it to turn it, then the energy of the induced current is equal to the work done by the currents during the motion, or $K = E\ C$. If K is greater than E C at first, then the machine will go faster and faster, and E and C will increase, until the product becomes equal to K, when the motion will remain steady. Hence such a machine should give induction currents of the greatest efficiency when used as a motor.

The above conclusions have been arrived at by considering the attractive and repulsive forces between different parts of a battery current, where the electro-motive force of the battery does not change.

MAGNETIC MACHINES.

The same reasoning will apply to the case where a permanent magnet is used in place of the original battery current, a closed circuit being moved in the magnetic field, or a magnet moved in the neighbourhood of a fixed coil. In fact, the theory of Ampère requires that a small closed current should be equivalent to a magnetic molecule, and so a collection of equal small closed currents, all going the same way, and occupying a given area, is equivalent to a collection of equal magnetic molecules with their poles in the same direction, *i.e.*, to a magnet. But a collection of equal small closed currents all going the same way, and occupying a given area, is equivalent to a current around that area.

We may readily express the efficiency of magneto-electric machines by a formula. Taking k to be the effective work done by a unit current in one turn of the armature, and n the number of turns in a minute, and C the strength of the current, the total effective work is C^2nk; and the work done in overcoming the resistance, R, of the circuit is $C^2R\theta$: hence, by Joule"s and Ohm's laws, if E be the electro-motive force,

$$EC = C^2nk + C^2R.$$

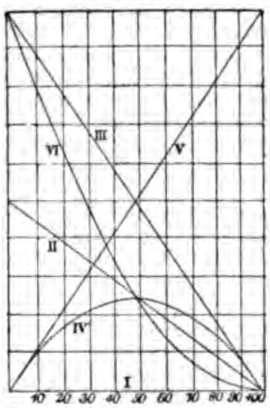
$$\text{Hence the efficiency} = \frac{C^2nk}{C^2nk + C^2R} = \frac{1}{1 + \frac{R}{nk}}$$

Thus, for a given resistance, the greater the number of turns of the machine, the greater is the efficiency, and the higher the resistance, the less the efficiency. This formula shows that machines and lamps of high resistance can only be efficient when the machines are revolving at a high speed.

We may represent the efficiency of batteries or

magnetic machines which are employed to drive an electro-motor, such as a dynamo-electric machine, by a diagram from *La Lumière Electrique*, in which the electro-motive force of the battery or exciting machine is measured on a horizontal line, and either the current or the energy expended is represented by vertical lines. The total electrical energy, represented by a straight line (III.), is the sum of the effective work (IV.), and the loss of energy by heating, &c. (VI.).

FIG. C.



I. Electromotive force.
II. Strength of current.
III. Energy converted into electricity.
IV. Effective work in the external circuit.
V. The efficiency.
VI. Energy not converted into useful work.

It will be seen that when the efficiency is ½, the greatest amount of effective work is produced, and this amount of work is one-half the total electrical energy. Since the electro-motive force is proportional to the number of revolutions a minute, this diagram gives the effective work and efficiency at different speeds.

In the case where the fixed and the movable parts of the machine are electro-magnets, and the same current passes round both, then we have—

(1.) The action of the currents on one another.

(2.) The action of the fixed magnetic core on the moveable coil, and of the moveable magnetic core on the fixed coil.

(3.) The action of the two magnetic cores on one another.

Hence the value of k is of the form $a + bm + cm^2$, where a, b, c are constants, and m depends on the magnetic properties of the cores.

Each of these actions arises from the influence of two equal currents on one another, and, therefore, will be proportional to the square of the current, and to the number of turns of the coil in a minute, so that—

K is proportional to $n\,C^2\,(a + bm + cm^2)$

and the efficiency—

$$\rho = \frac{1}{1 + \frac{e_2\,R}{K}} = \frac{1}{1 + \frac{R}{n\,(a + bm + cm^2)}}.$$

The most important part of the action in such machines depends on the action of the two magnetic cores one upon another. Th between the fixed and the moveable cor great disturbance, in consequence of th taking up their full magnetism ins requiring time for their full magnetisati sequence of this, in all dynamo-electric is necessary to allow the rotation to go an angle determined by the retardat magnetism of the cores, before takin current from the machine to do ext hence, in order to get the greatest springs for making contact must in su shifted round in the direction in which is taking place. Faraday attributed t tion to the time required to develop th currents in the molecules of the magne

ALTERNATE-CURRENT MAGNETO-M

In alternate-current machines, there mutator for making the current conti the currents from the coil are collecte through the external resistance in opp tions for every half-turn of the arma earliest of these was the "Alliance" electric machine, which has been adop French Government for lighthouse ill Holmes converted this into a continuo machine, and was the first to produce the electric light on a grand scale for illumination. He afterwards removed mutator, and again converted it into an current machine.

The four methods of placing the coils volving wheel, in machines for electric which have been employed in lightho been summed up by Mr. Douglass:—

1. In Holmes's magneto-electric ma bobbins are arranged transversely, with parallel to the axis of rotation around t ference of the wheel.

2. In Siemens' machines, the wires a wise, and revolve about the long axis of on which they are wound.

3. In Gramme's machines, the wires f around a ring.

4. In the De Meritens machines, th wound as in the Gramme, but are di separate parts, which are insulated another, and passing in succession in opposite poles of magnets, give off currents.

THE SIEMENS ALTERNATE-CURRENT M

A central disc carrying bobbins is s angles to a shaft, and revolves between t electro-magnets ranged in circles on ea the disc, having their axes parallel to The bobbins have no iron cores, and so t caused by magnetisation and demagne the iron is avoided. The electro-ma excited by a small Siemens continuo machine.

This is similar to Wilde's dynam machine, which he produced in 1866, e in the coils on his cast-iron disc Wilde p iron cores, and arranged them so as to groups of four each. The current fr these groups excites the electro-magnets, other seven groups give out the current f use. Among the more recent altern

es, arranged so as to be excited by a separate ,ous current machine, there is one which has ›een invented by M. Gramme, in which the of the continuous-current machine, which the magnets, is placed on the same axis e rotating armature which gave the alter- rrents, so that the two turn with the same r, and the combined machines run at the ıte. This is much simpler than having two es, and it is called a self-acting machine.

ı principles which I have already explained, eatest amount of effective work or yield d from an alternate-current machine, driven parate exciter, is not more than 50 per cent. electrical work given out by the first e.

sult of M. Mascart and M. Jamin's Experiments.

Jamin has found that, in the Alliance ıe for electric light and giving alternate s, the strength of current can be calculated ı's law, considering the electro-motive force portional to the velocity, but replacing the ıce of the bobbins by a resistance about imes as great. The resistance to be added ortional to the velocity of the machine.

heoretical determinations of the efficiency hines are complicated by the retardation of isation of the magnets, which necessitates ge of position of the commutator in the ɔn of the rotation of the armature. If this ı were not made, then it would be possible, bobbin in which the wire resistance was to get currents in opposite directions when il is rotated at different rates. For slow n, the galvanometer needle is deviated side; on increasing the velocity of rotation, rrent is increased, at last reaches a maxi- and beyond that diminishes rapidly to g, and becomes negative; as the velocity is creased the current reaches its greatest nega- lue, and then increases again, and may have l such fluctuations.

efficiency of the Siemens dynamo-electric nes has been examined experimentally by . W. Siemens, who has communicated the ı of his investigations to the Royal Society, y Dr. Hopkinson, whose results are pub- in the "Transactions of the Institution of ınical Engineers;" also M. Hospitalier and s. Auerbach and Meyer have experimented amme machines, and M. Mascart and Angot considered the subject, both theoretically and cally, in some excellent papers which have given in the "Journal de Physique."

ing the experiments of M. Hospitalier as in *La Lumière Electrique*, we get the results, wn in the diagram.

	Ohms.
otal resistance of the machine before the experiment, was	1·185
" " of the heated bobbin	.75
" " of the heated electro-magnet	·72
Total	1·47

sistances are laid down on the horizontal line he scale of 1 c.m. per ohm.

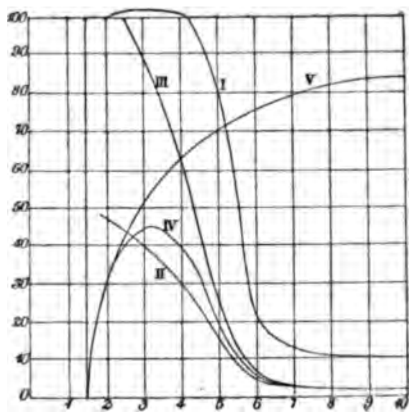
cale of electro-motive force (I.) is 1 c.m. for olts.

The scale for currents (II.) is 1 c.m. for 10 webers. The scale for work (III. and IV.) is 1 c.m. for 20 kilo-grammètres.

Curve (V.) represents the efficiency, *i.e.*, the ratio of the effective work in the outer circuit to the total work converted into electricity.

This curve expresses the ratio of the external work to the total work produced, and approaches the value unity as the resistance is increased; but for high resistances very little work is produced.

Fig. D.



I. Electromotive force.
II. Strength of current.
III. Energy converted into electricity.
IV. Useful work in the external circuit.
V. Efficiency.

From the curves it would appear that this Gramme machine does most effective work in the outer current, without greatly heating the internal circuit, when the total resistance is about 4 ohms, *i.e.*, when the external resistance is about twice as great as the internal resistance. For less resistances the machine is greatly heated from the amount of internal work consumed, and for higher resistances the work converted into electricity becomes very small. The following numbers give the results of one experiment with the dynamo-machine:—

No. of turns a minute	1,000
External resistance	2·7 ohms
Current	25·5 webers
Electro-motive power	107 volts
Total work converted into electricity	3·64 h.p.
Effective work in external circuit	2·38 h.-p.

The efficiency in this case is 65 per cent. The effective work in the outer circuit is not more than 50 per cent. of the total work done to produce it.

With Gramme Machine.

In Auerbach and Meyer's experiments for 800 revolutions a minute, the maximum electro-motive force is 76 volts, and for 51 volts, or two-thirds of the maximum value, there is a current of 6·5 webers through a resistance of 7·8 ohms. Below this value the current is unsteady. With Siemens's machine, a speed of 700 revolutions a minute gave a maximum electro-motive force of 76 volts, and for 51 volts there is a current of 15 webers through a resistance of ·6654 ohms. With

a small Siemens machine, a speed of 1,000 revolutions per minute gave a maximum electro-motive force of 42 volts, and for two-thirds of this, or 28 volts, the current was 11·2 webers through about 2·2 ohms resistance.

Dr. Hopkinson has investigated the way in which the electro-motive force in a Siemens machine depends on the current. He has shown that:—

(1.) The electro-motive force is for a given current, proportional to the speed of revolution of the armature.

(2.) That the electro-motive force does not increase indefinitely with increasing current, but,

(3.) Only increases in the direct ratio as the current increases up to about two-thirds of its maximum value.

The current is very unstable for small changes of resistance, or of speed of engine, as long as the value of electro-motive force is less than two-thirds of its maximum value. There is a remarkable difference in the ratio $\frac{E}{C}$, depending on change of speed from 660 to 700 revolutions a minute, shown in Fig. 1, where the current changes from 5 to 15 webers, for this increase of one-tenth of the speed.

As regards the relation of work converted into electrical energy to the work expended to produce it, it appears from the experiments of Mr. Schwendler and Dr. Hopkinson that, with the Siemens machines employed by them, the loss of power was from 12 to 14 per cent., so that if the external resistance of the circuit, *i.e.*, the electric lamp, &c., be so adjusted that half the total work produced appears in the arc, then 43 or 44 per cent. of the total work expended is produced in the arc.

The results arrived at by Dr. Siemens with his latest machine on Wheatstone's principle are—(1.) That the electro-motive force, instead of diminishing with increased resistance, increases at first rapidly, and then more slowly towards an asymptote. (2.) That the current in the outer circuit is actually greater for a resistance of 1½ ohms than for one ohm.

With a current of 30 or 40 webers the horse-power expended was 2·44 h.p., and the effective work 1·29 h.p., giving an efficiency of 53 per cent., as compared with 45 per cent. in the ordinary Siemens machine. The maximum energy which can be converted into heat in the machine is 1·3 h.p. The new machine will give a steadier light with greater economy, and may be driven by a smaller engine.

The Brush Machine.

Among the later continuous current machines are two which promise to be very successful machines. The Brush, with a ring on the Gramme system, with eight divisions or portions hollowed out to receive the coils, the bobbins at opposite ends of a diameter being connected together and to a commutator. When a pair of bobbins passes the neutral point, so that there is no current in it, it is put out of circuit for one-eighth of a revolution, so that the current produced in the other bobbins is not wasted, by being sent through the resistance of the two which are producing no current. On the inducing magnets are wound fine wires, offering considerable resistanc carry the current when the external ci open, and keep up the magnetism; but w circuit is closed, the thick wires on the carry the principal part of the current.

The internal resistance of the machi about 10½ ohms, and the external resis ohms, there was, according to calcul current of 10 webers, and an electro-mot of 839 volts. With these numbers, the work on the external circuit ought to be the whole electrical work produced; bu tically, it is only 61 per cent.

The relation of work converted into e to the work expended in this machine, 73 per cent., whereas with both Gram Siemens's machines, with relatively smaller resistances, this ratio is about 88 per cent.

Another continuous-current machine Bürgin machine from Switzerland, which just been introduced into England by Mr. Cr

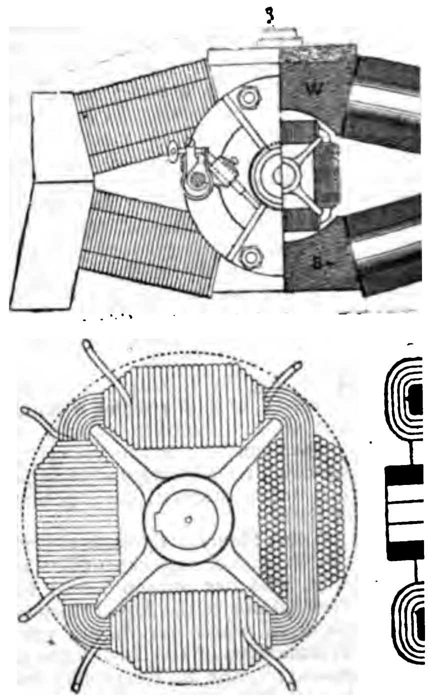


Fig. E.—The Bürgin Machine.

Four or six coils are wound on the si square or hexagonal frame, consisting of ir The corners of the frame come very nea poles of the magnets. There are six or these frames arranged successively in th a helix. The action is similar to that of the machine, the dynamo-electric principle bei duced in this as in other machines. The tion of the machine is very simple, and its has been proved by M. du Moncel and al Crompton to be remarkably good. These are of small internal resistance, and are high speeds (up to 1,600 revolutions a mi that there is considerable electro-motive f

The efficiency of certain Gramme mac

by Mr. Crompton, and tested at the r Electric Light Exhibition, was shown to that, with a power of 4 h.p. expended in ng the current, only ½ h.p. was expended on and passive resistances, so that about 88 . was nett power. This 3½ h.p. converted tricity gave a current of 32 webers through ance of about 2 ohms, *i.e.*, an internal ce of 1·077 ohms, and the arc of a Cromp- np giving a light equivalent to 2,158

we may compare with these the results d by Mr. Crompton for the Bürgin machine, at a speed of 1,675 revolutions per

machines were tested, and the total work ed was 5·45 h.p. The amount spent on and passive resistances, when the circuit en, was about ·25 h.p., so that about 86 t. is nett power. The work converted into al energy, 5·2 h.p., gave a current of 20·15 , through an internal resistance and con- wires of 2·8 ohms, together with the arcs ompton lamps (about 5 ohms), each giving a 2,103 candles, measured horizontally; the ·motive force $= \frac{\text{work}}{\text{current}}$ being equivalent rolts.

. photometric measurements made hori- y, the electric light being level with the t, the carbons being concentrically adjusted, length of the arc being about 3 m.m., the t amount of light was found to be obtained 5 revolutions per minute, with 3 lamps, f 2,103 candles, or with 4 lamps, each of andles. The upper carbon was 10 m.m., e negative carbon 13 m.m. in thickness. nsumption of the upper carbon was 4 c.m., e lower nearly 2 c.m. per hour. The total ower expended was 5·55 h.-p., and the , with 3 lamps, varied from 18·36 to 21·94 , and with 4 lamps, from 16·9 to 19·6 . All three lights were very steady, and vhiter than the single lights of Gramme's e.

Crompton has been kind enough to lend me, ening, a new Bürgin machine, about which s me the following facts:—It was tried at revolutions a minute, and a current of 28 was sent by it through 3 lamps, in series. the arcs were lengthened to one-fourth of h each, the current was 24 webers, and the ve a light of 5,000 candles each, the photo- measurements being made in the most tageous direction.

British Electric Light Company have been nough to place at my disposal for this even- d for my lecture next week, two Gramme nes for trying some of the electric lamps have been kindly lent to me.

e machines are driven by a steam-engine, y Messrs. Robey, of Lincoln, and for the e and other electric lamps I am indebted to the British Electric Light Company; to emens; to Mr. Crompton; to Mr. Latimer for the Lontin lamp; for the Rapieff and electric candle, to Mr. Berly; to the Jab- ff Electric Light Company for their candles; the Anglo-American Electric Light Com- or the Brush lamp.

THE BROCKIE LAMP.

The upper carbon is attached to an iron tube, which passes into a solenoid, through which it passes as the positive carbon burns away. The solenoid forms a shunt or by-pass for the arc, and takes a small part of the current, and holds up the iron tube which carries the upper carbon; as more current passes through the coils, the motion of the carbon is stopped.

A commutator is so arranged and driven by the dynamo-machine as to break the current, and allow the carbons to come in contact for an instant at regular intervals, say every minute. Then the circuit is completed again, the upper carbon is drawn to its proper distance apart, and the light continues. At every minute the light goes out, but instantly relights, and no variation of light is perceived.

SIEMENS' DIFFERENTIAL LAMP.

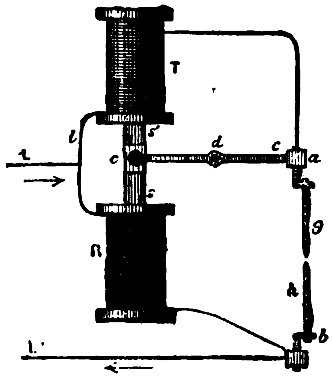


FIG. F.—SIEMENS' DIFFERENTIAL LAMP.

A thick wire bobbin, T, carries the arc current, and another fine wire bobbin, R, forms a shunt to the arc. The interval between the bobbins equals the height of each of them. The iron rod, S S, is of twice the length of each bobbin, and its ends in the normal position are at the centres of the bobbins. The attraction by the thick wire bobbin tends to lengthen the arc and diminish the current, and so its attraction is weakened, and the arc is again diminished, the attraction on the iron being regulated by the change of resistance in the arc. A pendulum arrangement is attached, to prevent the oscillations of the carbon from being too sudden.

CROMPTON LAMP.

The carbons are brought together by means of the weight of the upper carbon holder, as in the Serrin lamps. The carbons are controlled by means of an electro-magnet, of which the principal armature separates the carbons, and a light secondary armature is arranged on the back of the large one, and does the more delicate work of bringing the carbons together. The large armature supports the negative or lower carbon; and when the small armature has brought the carbons together, so that a current passes, the large armature separates them to the proper distance apart for a good light. When the arc is broken, the armature, supported by a spring, is raised, and brings the carbons into

contact, and re-lights the lamp. The small variations in the strength of current re-act on the second armature, which is held at some distance above the large armature by a light spiral spring. The small armature carries an arm, which is applied as a brake to a brake-wheel, which is the last wheel of a train of wheels, set in motion by the weight of the positive carbon-rod.

Regulator in Brush System.

A very pretty arrangement for shunting the current past a lamp (when it is not in use), so that one lamp may be put out without affecting the other lamps in the circuit, is adopted on the Brush system.

The current passes through a solenoid coil, wound with thick wire, and then passes to the upper carbon, through the arc to the lower carbon, and then by the frame to the next lamp. The solenoid holds up a rod of iron, which tilts a ring on one side, through which the carbon passes, and so locks it. To the end of a thick wire of the solenoid is attached a thin wire (150 ohms), which is also wound on the solenoid, and which forms a shunt or by-pass to the arc, taking more and more of the current as the resistance of the arc increases. This thin wire is wound the opposite way, and the current in it relaxes the hold on the carbon, so that it falls slowly, and then takes more of the current. As soon as it does so, it is again held fast. To prevent the carbon from falling too rapidly, it is passed through a vessel containing glycerine, and slides downwards very slowly. The current through the thin wire also passes through another solenoid, which forms a shunt or by-pass to the whole lamp, so as to take all the current past the lamp if it should get out of order. When a considerable current flows by this path—*i.e.*, if the arc becomes an inch long, so that its resistance is greatly increased—the second solenoid draws up a piece of iron, which lets all the current pass and the lamp is thrown out of the circuit.

In the Brush lamp, which is designed to burn 16 hours, there are two pairs of carbons, with the rings on the upper carbons, which hold them by friction, so adjusted that one is held about one-fourth of an inch above the other, and, therefore, the second carbon will not come into action until the first falls or is burnt out.

All the electric candles, such as the Jablochkoff candle, the Jamin candle, the Wilde candle, and the De Meritens candle, consisting of three carbons, are fed by means of alternate current machines, because it is essential that the two carbons should burn away equally. In the Jamin and the Wilde candle the carbons are at first in contact, but when the current passes, one of the carbons is separated from the other, because its holder is set on a hinge, so as to be acted upon by a small electro-magnet through which the current passes.

M. Joubert has found that it is necessary, in order to keep the arc steady with the Jablochkoff candle, that the alternate current in the circuit should have a mean value of eight or nine webers, and that below five webers the arc cannot be kept alight; between the bases of the two carbons forming the candle there is an electro-motive force of 40 or 45 volts. The Jablochkoff candle uses up about 66 kilogrammètres of work, of which 33 kilogrammètres, or 4·6 h.p.[illegible] verted into heat and light.

When the arc is produced in a magne[illegible] either by disturbing it by an electro-ma[illegible] by placing a frame around it, as in th[illegible] candle, it is necessary to have a current large again as when the electro-magnet i[illegible] action. One-third of the energy of the c[illegible] in such a case spent in producing a strong [illegible] field around the electric arc, and is, ther[illegible] much wasted energy, as far as the electri[illegible] concerned.

MISCELLANEOUS.

THE SYMPATHETIC TELEGRAP[illegible]

The following article on the curious su[illegible] relating to a sympathetic telegraph is taken [illegible] *Antiquary*:—

> Or sympathy, or some connat'ral force,
> Pow'rful at greatest distance to unite,
> With secret amity, things of like kind,
> By secretest conveyance.

So wrote Milton, and so have thought man[illegible] more particularly the famous but credulous Si[illegible] Digby, who, in 1657, delivered a discourse [illegible] pelier, "Touching the Cure of Wounds by th[illegible] of Sympathy," which was afterwards [illegible] into English by R. White, and who is [illegible] have cured Howell the letterwriter's cut [illegible] the use of the powder at a considerable dista[illegible] the wounds. When the mariner's compass ca[illegible] generally known, as it was apparently in th[illegible] century, the supposed wonders of magnetism have attracted the attention of imaginativ[illegible] Alexander Neckam, monk of St. Alban's (b[illegible] died 1217), has the credit of being the [illegible] European writer to allude to the compass. [illegible] evidently the remarkable movements of the ne[illegible] first induced dreamy philosophers to believ[illegible] sympathetic telegraph was a possibility. One [illegible] tion is well known, which Addison contribut[illegible] *Spectator*, "of a chimerical correspondence bet[illegible] friends by the help of a certain loadstone, w[illegible] such virtue in it that if it touched two several [illegible] when one of the needles so touched began to [illegible] other, though at never so great a distance, mo[illegible] same time and in the manner." This is ta[illegible] Strada's "Prolusions," but earlier writers ha[illegible] to the supposed phenomenon, and Mr. Latin[illegible] has collected a curious series of books re[illegible] the subject, which he has sent to be s[illegible] the Paris Electrical Exhibition.* The [illegible] Baptista Porta was the first to describe the sy[illegible] telegraph, which he did in 1558 in his "Natura[illegible] He is said to have derived the idea from Cardi[illegible] Bembo (1470-1547), but the observations of [illegible] brated historian and poet on the subject hav[illegible] been traced.

Daniel Schwenter, of Nuremberg, who wr[illegible] the assumed name of Jacobus Herculeus de S[illegible] the next (in 1600) to allude to the supposed in[illegible] He described how attention was drawn by th[illegible] of bells by means of bar magnets, and how [illegible] were formed by one, two, or three strokes to [illegible] or left. His ideas were purely cabalistic, bu[illegible] cription singularly coincides with some of th[illegible]

* Mr. Clark has kindly supplied the writer with a [illegible] books, made by Mr. Frost, Librarian of the Society o[illegible] Engineers, from which, with some reference to the [illegible] selves, this article has been drawn up.

ɜrn telegraph. B. de Boot, the author of the eweller," drew attention to the telegraph in then in the year 1617, Famianus Strada iis "Prolusions Academicæ." In this book printed those verses describing the imaginary ɜgraph, which were witten in imitation of and have themselves been constantly trans- nitated by later writers. One of these was eorge Hakewill, D.D., Archdeacon of Surrey, a curious book full of the learning of his ı he entitled, "An Apologie or Declaration er and Providence of God in the Government ld." It is a folio volume, printed in London, Allott, in the year 1630. The fourth section l book is, "Of the Use and Invention of the Compasse or Sea Card, as also of another ıvention, said to be lately found out upon the ;;" and this section contains a versified of Strada, of which, as it is less known, a s here given in preference to the original.

you of ought would faine advise your friend
far off, to whom no letter you can send,
ıth round table make, write down the Christcrosse

he verge thereof, and then bestow
ı the mid'st which touch't the loade, that so
ɔe're you lift it straight may turne unto;
another orbe, in all respects like this,
edge, and lay the steele thereon likewise,
ıich from the self-same Magnes motion drew;
ıd with thy friend what time he bids adieu;
ayes agree first when you mean to prove
stirred and to what letter it doth move
with thy friend thou closely would advise,
ıntry off farre distant from thee lies,
ıe orbe and steele which on the orbe was set,
osse on the edge thou see'st in order writ,
will frame thy words to them direct thy steele,
times to this, sometimes to that note wheele,
ɔund about so often till you finde
mpounded all the meaning of your minde.
hat dwells far off, O strange! doth plainly see
stirre, though it by no man stirred bee,
w heere, now there, he conscious of the plot,
guides, pursues and reades from note to note;
ing into words those notes, he clearly sees,
ful to be done, the needle truchman [interpretor] is,
ıe steele doth cease its motion, if thy friend
nvenient answers back to send,
urse he may take, and with his needle write.
e severall notes what so he list indite.

kewill then goes on to refer to the Annota- 'iginerius upon T. Livius, and as he con- y refers to his authorities, he tells us that, on ı column of his first volume, that author says: ter might be read through a stone wall of three e, by guiding and moving the needle of a ɔver the letters of the alphabet written in the nce; but the certainty of this conclusion I e experiment of such as list to make tryall of

ır before Dr. Hakewill's "Apology" ap- icholas Cabeus published his "Philosophia ," and in that work he gave the first picture graph. It merely showed a round dial with a se" alphabet all round its outer edge, and a ıeedle loosely attached at the centre. Robert ıs the first English writer to represent this this he did in his translation of "Ars he Notory Art of Solomon" (1657). His figure to that of Cabeus, with this exception, ıses an alphabet of capitals in place of ıall letters. He describes the pure steel like that used in seamen's compasses, but of gnitude, so that after being touched by the load- ıay be cut in two, when each needle must be ı separate box. In one of Bishop Wilkins's ɔoks, "Mercury, or the Secret and Swift :: showing how a man may, with privacy and ımunicate his thoughts to a friend at any (1641), the author alludes to the sympathetic although he does not believe in its virtues. ɛenth chapter is "of those common relations that concerne secret and swift information by the species of sight which are either fabulous or magical," and here he writes, "first of those that are fabulous. In which kind, that of the loadstone is most remarkable, as it is maintained by Famianus Strada in his imitation of Lucretius his stile and divers others."

Besides the authors already referred to, there are a large number of others who either describe the instrument or make a passing allusion to it. Of these the most prominent are H. Van Etten (1624), Pancirollus (1629), A. Kircher (1631), Galileo (1632), Sir Thomas Brown (1646), J. Glanvill (1661), Wynant van Westen (1663), Gaspar Schott (1665), W. E. Heidel (1676), L. H. Hillier (1682), De Lanis (1684), and De Vallemont (1696). It is a singular instance of the way in which we copy one from another, that so many writers should have made mention of this purely mythical instrument, some of them apparently with undoubting faith in its virtues.

In an indirect manner, the name of an eminent statesman is connected with this famous dial. Cardinal Richelieu had private agents in many countries, who kept him so well informed with news, that those who knew nothing of the agents thought it necessary to find some explanation of his early knowledge of events, which seemed to them almost like a prophetic power; so they gave out that Richelieu possessed a sympathetic telegraph. The wily Cardinal blandly denied the rumour with smiles, and was not sorry that those around him should be thrown off the right scent.

Some persons believed that the dial might be made with human flesh. A piece of flesh was cut from the arms of two persons, and, while still warm and bleeding, was mutually transplanted. The severed piece grew to the new arm, but retained its sympathy with the old, so that the former possessor was sensible of any injury that it underwent. When the flesh had grown to the new arms, letters were tattoed upon the transplanted pieces; and on one of the letters of one being pricked with a magnetic needle, the friend at a distance immediately felt a sympathetic pain on the same letter on his arm. This reminds one of Taliacotius and his remarkable operations, which inspired Edmund About to write his curious novel, "Le Nez d'un Notaire," in which he relates the odd results of sympathy between the notary's nose and the arm of the man from whom the flesh was taken.

Allusion has already been made to Addison's remarks in the *Spectator* (No. 241) upon Strada's account, and it is worth mention, as a curiosity of literature, that the celebrated essayist actually repeated his remarks word for word in the *Guardian* (No. 119). One of the latest translations of Strada's verses will be found in an Oxford magazine entitled "The Student," which opens thus:

With magic virtues fraught, of sov'reign use,
Magnesia's mines a wondrous stone produce.

Although the telegraph, about which we have been writing, was purely sympathetic, and no provision was made for a connecting wire, yet some may consider it a curious prevision of what has since been successfully carried out. The dial certainly does appear to have borne a singular likeness to a Wheatstone A B C telegraph. The Rev. Joseph Glanvill looked forward in Charles II's reign to the time when communication of this character would be general. That singular man wrote as follows, in a work addressed to the Royal Society:—

"I doubt not but that posterity will find many things that now are but rumours verified into practical realities. . . . . To those who come after it may be as ordinary to buy a pair of wings to fly into the remotest regions as now a pair of boots to ride a journey, and to confer at the distance of the Indies by sympathetic conveyances may be as usual to future times as to us in literary correspondence."

There shall be a central school of cookery, in which lessons in the highest and the humblest branches of the art would be given. As West Herts has no towns large enough to support a permanent school, the school of cookery would not remain in one town, but would pass, with its staff and *batterie de cuisine*, through the leading towns of West Herts—Watford, St. Alban's, Berkhamstead, Hitchin, &c., staying about six months in each town, and returning to its former stations every three or four years. To reach the elementary schools arrangements would be made in each town for training teachers specially prepared in the system which has been for several years successfully carried out at Watford-heath, Berkhamstead, and Bushey. Apprentices of about 17 years would be regularly bound to the association for [three] years, paying an apprenticeship fee of about £10, to protect the association from possible loss on training. Their pay would be [£15] for the first year, [£30] for the second year, and [£45] for the third year, with power on the part of the association to cancel the engagement at any time. After about six months' training, the apprentice would be sent out to teach in elementary schools desirous of having lessons. No charge would be made to the schools for these lessons. The only expenses falling upon the schools would be the cost of furnishing, and of any loss on food, which at the outside should not amount to more than £5 a year. It is probable the Education Department will extend to England the grant of 5s. a head now made in Ireland for cookery. The association might fairly stipulate for a part or the whole of this grant. An apprentice would be able to teach five schools, at an average cost to the association of £6 a year for each school. If managers should prefer to train their own pupil-teachers specially to this work, arrangements would be made to meet their views. As the central school moved through the principal towns of West Herts, it would, it is hoped, supply the wants of the schools by one or other of these means. Cookery is at present taught in the schools of the large towns of England ; it is the country schools which are generally deficient in this teaching. By this plan of combination, it is thought that the difficulties which now deter country managers may be overcome. Those who are acquainted with the condition of the poor, as regards cookery, will doubtless sympathise with an effort to impart to them information as to the value of many foods

finish their arrangements. The princ
the main north pavilion, facing th
The eastern entrance is occupied by t
railway, by which visitors paying
can visit the building. The other ter
railway is on the Place de la Concord

The great hall of the Exhibiti
building, 250 mètres in length b
width. Lofty iron pillars suppo
arched roof of glass ; they are 8 mètr
galleries, the spaces under which cont
boilers, and dynamical apparatus.
Belleville boilers, which are heated b
16,000 lb. of steam per hour, or a
h.-p. nominal. There are also Otto
extent of 200 h.-p. more. This is t
by the French syndicate, which sup
for a charge of 33 per cent. on t
French, English, and Belgian manuf
provided many more steam-engine
for use by private contract.

An interesting collection of hist
apparatus arranged by Mr. H. R. K
by the Postmaster-General. Here
five-needle instrument constructed
1837, and specimens of the develop
instrument, from the complicated
simplified one-needle instrument, larg
in local circuits, and on railways ;
showing similar development, from t
the olden days of electricity to th
designed by Varley and Spagnoletti
Ronalds underground telegraph, a
Hammersmith as long ago as 1816.
is the first A.B.C. instrument of
structed by him in 1840. This is the we
apparatus, and may be compared with
instrument, as constructed in 1848, a
used by the old Magnetic Telegra
specimen of the first submarine cable
in 1850, is exhibited, as is Varley's
which was long used at the Central C
mission and distribution of time-signa
It is announced that the Technical
Exhibition are about to organise a se
lectures on some of the inventions ex
hibition will not be open to the publ

AL OF THE SOCIETY OF ARTS.

No. 1,502. VOL. XXIX.

?IDAY, SEPTEMBER 2, 1881.

...cations for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

ART FURNITURE EXHIBITION.

Exhibition of Works of Art Applied to ?e, in connection with the Exhibition of ?s at the Royal Albert Hall, is now open A non-transferable season ticket will be any member of the Society on application ecretary.

?EEDINGS OF THE SOCIETY.

CANTOR LECTURES.

?IENTIFIC PRINCIPLES INVOLVED IN ELECTRIC LIGHTING.

By Professor W. Grylls Adams, F.R.S.

E IV.—DELIVERED MONDAY, MARCH 28, 1881.

ions of the electric current.—Incandescent .—Luminous effects of electric currents in a ?n, and in various gases.

gas was first introduced extensively for purposes, many objections were raised to and among them was one which was l by Clement Desormes, in 1819, which is up in the following quotation :—

light is of a disagreeable yellow colour, entirely from that red and warm gleam of oil lamps; dazzling brightness; its distribution will be le and irregular, and it will be much dearer lighting, and, even if it should be improved, ill remain much dearer than those lights which ly possess."

?s Desormes had become accustomed to the ?m of oil lamps, and objected to the cold- the yellow gaslight, so, a year or two ago, r objection was raised against the electric at it was entirely different from the yellow rm gleam of gaslight; that it is of a ; brightness; that its distribution would be ?le and irregular; and that our streets ?e left in darkness.

objections do not seem to be so strongly p by the public as they were two years r they have seen several trials of the electric light; and, although there are many difficulties in the way, yet the fact that the electric lighthas all the colours more uniformly blended, and is, therefore, a whiter light than gas, and enables objects to be seen in their true colours, can hardly be urged any longer as an argument against its use. The same argument might be urged for the same reason against bright moonlight, or against the light of day, and in favour of a yellow London fog. The Kyrle Society, in its search after truth and beauty, must surely be strong supporters of the spread of the electric light.

If we turn to the Report of the House of Commons, we find the following statement :—

"A remarkable feature of the electric light is that it produces a transformation of energy in a singularly complete manner. Thus the energy of 1-horse power may be converted into gaslight, and yield a luminosity equal to 12-candle power. But the same amount of energy transformed into electric light produces 1,600-candle power."

The experiments of Mr. Schwendler, of Dr. Hopkinson, and of others, have shown that, both with the Siemens machine and with the Gramme machine, 88 per cent. of the total work expended is converted into electrical energy. Theory has established that, if the external resistance of the circuit is equal to the internal resistance of the battery or magneto-machine, the available work in the external circuit is a maximum.

Suppose, then, that we have 40 Grove's cells, each of ·25 ohms resistance, and of an electromotive force of 2 volts, the external resistance being 10 ohms—

$$\text{Then } Q = \frac{E}{R + r} = \frac{40\ E}{40 \times \cdot 25 + 10} = 4 \text{ webers,}$$

$$\text{And } EQ = 2 \times 4 \times 40 = 320.$$

The work done in the external circuit is $\frac{320}{9\cdot 81 \times 2}$ = 16 kilogrammetres per second nearly, or about $\frac{2}{9}$ h.p.

A small Gramme machine of the A type, having an internal resistance of 4·58 ohms, and with an external resistance of 4 ohms, gives an electric current of 17·5 webers and an electromotive force of 158·5 volts, giving an amount of work equivalent to 2 h.p., EQ = 160 × 17 nearly = 8 times the energy of 40 cells of Grove.

If we wished to replace such a machine by Grove's cells, we should have to arrange about 80 cells to get the same electro-motive force, and to make each cell about four times as large, or to arrange 320 cells in four sets of 80 in each set, to get the same amount of external work done as by the Gramme machine. This will show how impossible it is to do the work by voltaic batteries which can be done by magneto-electric machines.

The equation, work = EQ, may be satisfied in two ways—either by making Q large and E small, *i.e.*, making what is called a quantity machine which will only do effective work when the external resistance is small; or we may make Q small and E large, *i.e.*, what is called a tension machine, which requires an external resistance large enough to prevent the machine from being overheated, and to satisfy the relation for the greatest amount of external effective work.

small resistance, and in the other a smaller current is sent through nearly four times the resistance, and to do this a higher electro-motive force is required. This higher electro-motive force is obtained by increasing the number of turns of wire in the bobbin and in the magnet, so strengthening the magnetic field, and also by increasing the number of turns of the machine.

We arrive, then, at the conclusion that, to overcome higher resistances more effectively, higher electro-motive force, and therefore higher speed, is required. Now our resistances may be so high that an ordinary current of electricity, even from a dynamo-machine, will not pass through it, in which case we have to resort to another method of producing electricity, of still higher electro-motive force, but the quantity produced is then considerably diminished. We have then to take an induction coil, consisting of two coils, in one of which a current of electricity from a battery is passing, and by suddenly breaking and making this current, to obtain great changes of the magnetic field, and hence great electro-motive forces, and so get very powerful alternating currents. We know the effect of checking suddenly the flow of water in a pipe. Sometimes the increase of pressure so produced may be sufficient to burst the pipe, and this is one transformation of the energy of motion of the water. This is analogous to the development of the energy of the induction current by the sudden checking of the electric current in the primary circuit. Water may be raised to a high level by a series of sudden impulses, as in the hydraulic ram. A flow of a considerable quantity of water being suddenly stopped, there is at once a sudden increase of pressure, which is sufficient to lift a valve, and allow a small quantity of water to pass into the reservoir or air-chamber. This air-chamber regulates the action of the flow of water up the pipe from the reservoir, just as the resistance and capacity of the secondary circuit regulate the

kindly lent to me by Mr. La
these Joël lamps kindly lent
who has introduced several
the original Werdermann lam
the contact of carbon is very
an ohm; hence it will take
7 or 8 (or perhaps 10), arrang
same circuit, to equal the resis
arc. To work these lamps of
a low electro-motive force is
result is attained by driving
dynamo-electric machine at m
or by placing a considerable
series, so as to make their c
equal to or greater than the in
the machine. Thus a Gramme
at the rate of 1,200 revolutio
an electro-motive force of ab
give a current of 50 webers
lamps in series. But this
illumination of 320 candles in
with this current we get an il
candles in 10 lights. Now, th
to produce this rate of revol
machine, is about 9 or 10
Werdermann, or the Joel lamp
lights of 160 candles each for
expended.

Mr. Alex. Siemens lays dow
"Electric Lighting," that 4 l
15s. a ton, will produce 1 h.p.
and that, if a steam-engine be
an electric light of 6,000-can
would be 5d. per hour. If th
be produced by 15 lights of 4
cost would be 2s. 1d., or five ti
the cost for a 400-candle lig
rate of about 1⅔d. per hour.

Now, by comparison, we m
the price of the electric ligh
means of the Werdermann or
compare the light obtained by

he photometer on the same level 10 that the surface is illuminated eeding horizontally from the lamp. nps, whether Werdermann or arc e fed by a continuous-current ma- nt passes from the positive carbon always in the same direction; and , the upper positive carbon becomes a hollow; hence a portion of this s the light, and the greatest in- is not in a horizontal direction, at an angle of about 60° below The illumination in this direction is es—or even more than three times ion in the same horizontal plane ence, when it is said, in the report tests, that a dynamo-machine, at s per minute, will give a light of or an expenditure of 4 h.p.—the sured horizontally—we see that the a direction inclined downwards at)° below the horizon, would be or 4 h.p. or at least 1,625 candles will also explain why lights fed -current machines should be placed le height above the area to be his, combined with the fact that it mical to produce one very powerful of a large machine, than several o illuminate the same area to the vill explain why Dr. Siemens is re lamps at so great a height, for tric lights which we shall shortly unity of seeing in the City.

N OF THE ELECTRIC CURRENT.

t to which I propose to draw your vening is the sub-division of the

plest to regard first the case where ry of given electro-motive force. ording to Ohm's law,

$$E = C (R + r),$$

lectro-motive force, C the current, of the battery, and r the external he poles of the battery be joined resistances r_1 and r_2,

$$E = C \left(R + \frac{r_1 r_2}{r_1 + r_2}\right).$$

e of each branch is equal to r, and ent in each,

$$C (R + r) = 2 C_1 \left(R + \frac{r}{2}\right).$$

ts, $R = 1$ ohm, and $r = 100$ ohms,

$$= C (1 + 100) = 101 C,$$

$$= 2 C \quad 1 + 50) = 102 C_1.$$

sam current flows in each branch s on y one wire. If there are 10 l o 2 branches, and if C_x be the

$$C \quad (1 + 10) \quad 110 C_x,$$

n each branch is $\frac{100}{110}$ instead of $\frac{100}{102}$ ranches, and C_y be the current in

$$) = C_y (1 + 2) = 150 C_y,$$

thus the current in each is $\frac{100}{150}$ or $\frac{2}{3}$, and the heating or glowing effect is $\frac{4}{9}$ths of its value with only one branch.

Now, if with 50 branches in multiple arc, we diminish the external resistance of each branch so as to get the same current as at first through each branch,

$$\text{Then } E = C (R + r) \text{ at first,}$$

$$\text{And } E = 50 C \left(R + \frac{r_1}{50}\right) \text{ with 50 branches.}$$

$$\text{So that } (R + r) = 50 R + r_1,$$

$$\text{Or } r - r_1 = 49 R.$$

Hence with $R = 1$ and $r = 100$ ohms $r - r_1 = 49$ and the length left has a resistance of 51 ohms. The heating of each of these is $\frac{51}{100}$, or one-half of what it was with only one branch. Hence the glowing heat or light from such a resistance will be greater than from the unshortened wire, with the weaker current through it. In this case we get 50 circuits of 51 ohms each, so arranged that the heating effect in each circuit is ·51, or about one-half of what it was at first. Hence the amount of heat radiated from each is one-half of what it was at first. But there are 50 such circuits, therefore the total heat radiated is 25 times as much as it was with only one branch.

If the resistance of the battery and connecting wires is considerable, then we see that the addition of every additional branch circuit takes away greatly from the amount of heat radiated from each branch, so that this plan of sub-division by separate circuits can only be adopted with success when the internal resistance is small as compared with the external resistance. We see, then, that with small internal resistance, there is great gain in heating, and, therefore, in light-giving power, by arranging branch parallel circuits in multiple arc; but when the resistance of the battery and leading wires is considerable, the advantage of this arrangement is small, and very little sub-division is admissible.

INCANDESCENT LAMPS.

Now, let us consider the case of currents produced by means of dynamo-electric machines, in which the electro-motive force is not constant in the same machine for the same speed, but depends upon the resistance of the circuit. An electro-motive force of 100 volts produces a current of one weber through a resistance of 100 ohms, and Mr. Swan tells us that this current, through a lamp of that resistance, gives a 60-candle power light. Now, if we reduce the length of the carbon filament in the lamp without altering the current, we reduce the illuminating power in the same ratio. Suppose we take it as four-fifths of the length, *i.e.*, its resistance is then 80 ohms, and we shall get a 48-candle power light from the same current (one weber), *i.e.*, with an electro-motive force of 80 volts.

With two such lamps in series, we shall get two 48-candle power lights, with an electro-motive force of 160 volts, sending a current of one weber through them, *i.e.*, the two lamps should give out a light of six gas-burners of 16-candle power each,

and should be sufficient to illuminate a drawing-room in many of our London houses.

If we consider now how we are to produce this current, we find that a Bürgin machine, by the expenditure of 6 h.p., will send a current of 24 webers through an external resistance of about 7 ohms, giving an electro-motive force of 160 volts. If then we take two lamps in series, *i.e.*, 160 ohms, and arrange 24 distinct series, we shall get a combined resistance of $\frac{160}{24}$, or about 7 ohms, allowing for the resistance of connecting wires, and there will be a current of 1 weber through each circuit, *i.e.*, this machine should give us 48 lights each of 48-candle power. With a resistance of 50 ohms in each lamp, the number of lamps which may be supplied from the same machine will be double this number. If we reduce our electro-motive force from 100 volts to 80 volts, with the same length of carbon in the lamp, then we reduce the current from 1 weber to 8-10ths of a weber. This in the same resistance will reduce the illuminating power from 60 candles to a light of about 40-candle power, instead of a light of 48-candle power. Hence, with a given electro-motive force, more light is obtained, and, therefore, greater economy is affected by shortening the length of the carbon in the lamp, rather than by diminishing the current through the same length of carbon. Hence, the best results will be obtained in incandescent lamps by sending through them as strong a current as they will safely stand, and making the length of carbon such that the dynamo-machine employed will send such a current through them.

Take another case:—Suppose we have one lamp of 75 ohms resistance (*i.e.*, about 45-candle power). A Gramme machine or a Siemens's medium-sized machine will give an electro-motive force of 100 volts, and a current of about 25 webers, at the rate of 100 revolutions a minute, through an external resistance of about 3 ohms. Hence, if we have 25 lamps in separate branch circuits, or in multiple arc, we get 1 weber through each from such a machine, and get a light, according to Mr. Swan, of 45-candle power from each. Hence, such a machine will give us about 1,125-candle power illumination. The energy expended would be about 5 or 6 h.-p., so that the illumination would be about 200 candles per h.p.

We have seen above that, with the Siemens's alternate current machine, a 400-candle light requires about half a horse power; so that 1 h.p. will supply two lights of 400 candle power, from an alternate current machine, at the rate of 10d. for 3 hours. The same illumination can be obtained from gas, at 2s. for 3 hours. Now, two-thirds of this cost is for the supply of carbon, which becomes burnt in the arc. Hence, without this consumption of carbon, the expense per h.p. is only 10-9ths of 1d. per hour. Applying this to the case of incandescent lamps, in which our carbons do not wear out, we see that by a proper arrangement of the lamps we may get a 200-candle power light at the rate of 10-9ths of 1d. per hour.

Now, Mr. Alex. Siemens also states, in his paper, that at the rate of 3s. 6d. per 1,000 feet, the same illumination cannot be obtained from gas at less than 2d. per hour. Hence, allowing 8-9ths of 1d. an hour for the breakage of incandescent lamps, the cost of light by gas and b electric lamps would be nearly the

If we allow that only a light of 4 instead of 60-candle power, can be] rate, still the incandescent light car as an expensive light.

Now, in the absence of any actua let us assume the same law to h system as in the Siemens or the G In the Brush system a current of 1 through an internal resistance of 1 external resistance of 70 ohms Siemens machine, when the extern seven times the internal resistanc only 1-60th part of its value when internal resistances are equal, and 1- when the external is double the int The drawback to this arrangen that one-third of the total work be lost in heating the machine.

Taking the Brush machine as wo the difference of potential for each circuit is about 40 volts. Hence of potential of 16 lamps = ab With an external resistance of ' is a current of 10 webers. Henc incandescent lamps in 10 series a resistance of 70 ohms, we sha through each series. Put, then, of 100 ohms resistance, in each shall get 70 lamps from a Brush n 70 lamps are each of 60-candle are worked by an expenditure of the candle power is 4,200 candle or 262·5 candle power per h.p. this resistance are only heated, light of 30-candle power each, power per h.p. will have to be re

Thus we have seen that it is divide the electric current in suc to increase the amount of il may be obtained by means of machine, especially when the lig by the incandescent system of or Edison.

The earliest attempt to o candescence in a vacuum was 1843, who applied continuous conductors, and heated them l in a Torricellian vacuum. 1848 by Staite, who used an i and platinum wire, and env glass or some other non-c Konn employed graphite, candescent in an atmosphere there was no wasting away same principles have bee greater promise of succes attempts at producing ill incandescence. The earlie (1) because of the impo the consumption of the c in consequence of the mi it was impossible to get of exhaustion which we because of the presence hydrogen, which exists c in other substances. It our power of obtainin greatly extended, and si

;h vacua from the labours of Mr. Crookes, Swan and Mr. Lane-Fox have succeeded ing vacua from which all the air and hydrogen are exhausted, so that their laments and platinum wire connections without being destroyed, even when a f electricity strong enough to make them a brilliant incandescent light has been asly passing through them for months . Through the kindness of Mr. Swan, y friend and former pupil, Mr. Lane-Fox, e to show you this evening how well they ceeded in producing a brilliant, and yet a nd pleasant, incandescent light. This is a which many have sought in vain, and ould not have been attained except by ng together the results of investigations ave been recently carried on in several s of physics.

not conclude this course of lectures without my especial thanks to Mr. H. Trueman who has given me very valuable assistance, ing me to bring together a large collection ctrical apparatus, in illustration of the ing subject which I have had the honour g before you.

MISCELLANEOUS.

AGRICULURE IN TRAVANCORE.

ulture is here carried on, says *The Colonies and* ith some measure of practical skill and success rom lengthened experience, but with most primi- ruments, and needing much improvement as to g, rotation of crops, and the preparation of for the market. The principal native agricul- oducts are rice, cocoa-nut and other palms, and ous roots for food, besides coffee, which is cul- by European planters, with the aid of native Fruit trees also are grown, more or less, by e, and invariably planted as the beginning of e when waste land is cleared.

RICE.

is grown chiefly on irrigated or swamp land, dry or "hill" rice is grown wherever the soil ently rich to give a crop, and the rain sufficiently it to bring it to perfection. Most of the landed of the country consists of rice or "paddy" which vary greatly, however, in quality and , and consequently in value. The price of ." lands varies according to the soil, facilities gation, distance from the centres of population, returns they are capable of yielding. Some th only 30 rupees to 40 rupees per para (about hth of an acre); others cost up to 70 rupees (say, £56 per acre). The Government compensation lands taken for public purposes is only 14 rupees a. Land may be said to be worth generally 5 years' purchase. The produce of rice lands in ore ranges from fivefold to thirtyfold. There ular complaint that the land is deteriorating and rn less than in former days, which the old ascribe to diminished attention to sacred rites ties, but which arises from exhaustion of l through want of proper cultivation. In thern districts, where tillage is more careful, anuring better attended to, and the sun the clouds and rainfall being less, the has sometimes been known to be fortyfold; but farmers think they are well off with fifteenfold at each harvest—*i.e.*, twice in the year—and throughout the greater part of the country seven or eightfold, or in the south twelve to fifteenfold must be put down as the usual return. As it costs at least two paras (about two-fifths of a bushel) of grain in wages to sow one para of seed, a return of at least three times the seed sown is necessary to repay expenditure. A tenfold increase would be 80 paras, or 32 bushels, of "paddy," or rice in the husk. When cleaned of the husk this is reduced to half the quantity—say 16 bushels—weighing on an average 64¼ lbs. per bushel when raw. Old rice would be lighter, down to about 59 lbs. The produce, therefore, of an acre of good rice land may be averaged at 1,044 lbs. The total acreage of rice land under cultivation in Travancore is not exactly known, but a fresh survey and re-assessment are about to be undertaken. The survey of eighty years ago places it at about 400,000 acres; but since then much waste land has been brought under cultivation, and the total acreage cannot probably be taken at less than 500,000 acres. Whereas at the beginning of the century Travancore exported large quantities of paddy and rice (in 1843 no less than 281,000 candies of 654 lbs. each), and imported but a small quantity, the case is now totally reversed—exports being only about 70,000 rupees to 80,000 rupees in value, and imports (duty free) having risen from 4½ lacs of rupees seven years ago to 13¼ lacs in 1879. The produce of the country is, therefore, not sufficient for home consumption at the present time. This arises not only from the diminished production already referred to and from increase of population, but also from the general improvement of the circumstances of the lower castes, who can now afford to eat more rice in place of, or in addition to, fruits and vegetables, coarse roots, and inferior grains. Supposing the cultivated area of rice to be 500,000 acres, and the joint produce of the two crops fifteenfold, or 1,566 lbs. per acre; this divided amongst a population of 2¼ millions would give 312 lbs. of rice per head per annum for consumption. Imported rice to the value of 13¼ lacs of rupees would give (at a chuckram per pound) 15 lbs. per head additional.

COCOA-NUT.

The cultivation of the cocoa-nut extends over the whole of Travancore, which has hence been facetiously called Cocoanut-core! Forty-four years ago the total number of cocoa-nut trees was 11,100,000, and the increase since has been so considerable, much waste land having been planted with this valuable palm, that the present number cannot be estimated at less than 15 millions. These are almost invariably too closely planted to obtain full advantage of sun and air; but supposing they stood at the moderate distance of 20 feet apart (which is 109 to the acre) the area covered would amount to 137,000 acres. The soils best suited for the cocoa-nut are the sea-shore, the banks and alluvium of rivers, and level lands exposed to the sea-breeze; these conditinns abound in Travancore. Inland on the mountains the cocoa-nut will grow, but not bear fruit. The young plants generally require watering for the first two or three years, and must be protected from the inroads of cattle until they rise some feet above the ground. Ashes are supplied as manure at the beginning of the wet season, and the ground opened about the roots of the trees, which come into bearing some eight or ten years after planting. A cocoa-nut plantation is one of the most easily managed and most remunerative products of the country. The natives have but to put down the nuts and guard the trees more or less while attending to their other employments, and in due course, a permanent and profitable plantation is created. Europeans, however, seldom attempt such an investment, and few who have done so have succeeded in it. The price of 100 ordinary trees in the southern parts may be stated at about 400 rupees. These would pro-

It has been estimated that 60,000,000 of nuts and 15,000 candies of oil are annually consumed in the country. The trees are sometimes tapped for a few months, to procure the sweet juice, which, boiled while fresh, gives a palm sugar, and kept a day or two till it ferments, becomes toddy, a slightly intoxicating drink, somewhat like beer. The toddy also is distilled into arrack or native spirits. Other palm trees are also cultivated. Next to the cocoa-nut comes the palmyra, which is grown only in the drier districts towards Cape Comorin. The palmyra, with its sweet sap and sugar, leaves, timber, and fruit, furnishes a living to a great number of the Thanar caste in Travancore, and in Tinnevelly. The number of trees in 1880 was about 6,000,000. It is probable that no considerable increase has taken place since, as old trees are in demand for their timber, and the slow growth of this palm discourages planting. From 160,000 to 24,000 cwts. of the the sugar (jaggery) of this palm are annually exported, worth something over 3½ rupees per cwt. The beautiful areca palm is planted in damp, clayey soil, on the banks of tanks and rivers. Unlike the cocoa-nut it will thrive at a distance from the sea, and on the hills. It is grown very largely in North Travancore, whence the nuts are carried to the south by Syrian and other traders. The trees will grow two or three feet apart. The areca begins to bear in five years, and continues to produce for twenty-five years. The nuts are sold wholesale at six or eight chuckrams per thousand, and retail in Trevandrum at from eight to thirty-two for a chuckram, according to season and demand. 3,500 candies are annually exported to Bombay and other ports, the value of which is about 4½ lacs of rupees.

Yams.

Roots, vegetables, and fruits form a considerable proportion of the food of the population in Travancore. The forest and hill people dig out wild stringy yam-roots from the jungle as food in the hot season. Every native grows something, if he can, around his own dwelling for home use. The principal cultivated root-crops are yams (*Dioscorea*) of various sorts, the small tubers of which are planted out in the beginning of the rainy season and dug again within a year. Some of these roots grow, under favourable circumstances, to a large size, up to four feet in length and one in diameter.

made in the year 660 B.C.; it was
the Christian era that the art mad
advances. In the year 1223 A.D., g
were made in manufacture and deco
From that date to the sixteenth
potteries of Owari, Hizen, Mino,
Satsuma were established. The Rah
ware, was first made at Kioto, at th
the sixteenth century. The best ol
which is still the most admired, w
Hizen, in 1580 to 1585; the old S
1592. Consul-General Van Buren
clays are found in nearly all pa
and the different kinds are usual
proximity, and close to canals
is of considerable advantage, as
of transport. In all cases every va
in the manufacture of pottery is
state; there is no necessity to manuf
or fusible clays as is done in other
and which adds considerably to th
One of the peculiarities in the cla
that it contains both the fusible and
in such proportions as to make a light
cent, and durable porcelain. At Ar
is a clay found which contains 78¾
and 17¾ per cent. of alumina; fro
the delicate, translucent egg-shell
addition of any other matter. From
a clay is taken which has 50 per ce
per cent. of alumina; from this the
made. Potters' clay is found in v
in the provinces of Yamashiro, Hoki,
Higo, Owari, Mikaera, Idyn, Musa
the whole of Japan there are 283
clay is deposited; many of these or
clays, but they are all fitted for
various kinds of pottery. These c
powdered by means of what a
pounders," worked in some localiti
but the work is often done by han
then dried, and stored on boards or
dough does not go through the proc
The shaping is almost exclusively d
wheel, which is set on a pivot worl
eye. As a rule, the wheel is turned
self, but in Hizen it is kept in motion

re; these kilns are so constructed that the s from the lowest one, in addition to which has its own firing place. The result of this on is that the upper ones are by far the ted, and the ware is arranged accordingly; h requires the least baking, in the lower kiln, which requires the greatest heat, in the 'hese connecting kilns have the merit of being g, but they are usually small and badly con- and the heat in none of them is uniform. The ade from the silicious clay and potash extracted l ashes. This potash is not a pure white, and nts for the dirty colour usually to be observed ed Japanese ware. In different districts the raries. For instance, in Owari the greater e ware is painted a cobalt blue—the cobalt ore d in the bluffs near the clay deposits, and is ainting the cheaper wares, and for this pur- ian cobalt is also employed. The painting lt is generally done on the biscuit before In several districts a very handsome ware nd painted on the glaze. For this kind of he colours are mixed with a silicate of lead sh, and baked the third time in a small a low temperature. The colouring oxides in hose of copper, cobalt, iron, antimony, e, and gold. Japanese porcelain painting livided into two categories, decorative and the first is used to improve the vessel upon is placed, and this class includes all the pt that of the province of Kaga, which ne under the head of graphic, as it delineates ides, occupations, sports, customs and cos- he people, as well as the scenery, flora, and the country. "Owari ware" is made in nce of that name; it is not as translucent, rer and more tenacious than some of the nufacture. The principal potteries are at a illed Sèto, twelve miles from the sea; in ge there are more than 200 kilns. The mostly painted a cobalt blue, and is merely ative kind, consisting of branches of trees, vers, birds and insects, all these being copied ist from nature. All the Owari ware is true lain, and is strong and durable. In Hizen, of wares are manufactured, the best known g the "Eurari," which is made at Arita, but t Eurari. The colours in use are red, blue, d gold; these are combined in various pro- out, as a rule, the red predominates. Generally e of the vessel is divided into medallions of hich alternately have red, blue, or white back- ith figures in green or blue and gold. The porcelain sold at Nagasaki is made in this rom Arita clay, and this is made from clay admixture of fusible matter except that by the clay naturally. The province of is noted for crackled ware. It is only very few years that large vases have nufactured, and in earlier days the old confined to small vessels. The glaze is a alumina and potash, and the best ware has a net-work of the finest crackles; the painting and flowers, and noted for its delicate lines red, and gold. In Kioto the ware manu- s very similar to that produced in Satsuma, lighter and more porous, the decorations are y the same, being of birds and flowers. There ption of ware made in Kioto, called "Eraku," body of which is covered with a red oxide of over this mythical figures of gold are traced. duced in Kaga is *faïence*, and in the style g is unlike any other in Japan, the predomi- lour being a light red, used with green and e designs with which it is profusely decorated grasses, flowers, birds, and figures of all people, with their costumes, occupations, and pastimes. The "Banko" ware is made at the head of the Owari Bay; it is an unglazed stone-ware, very light and durable, made on moulds in irregular shapes, and decorated with figures in relief. On the island of Awadji, a delicate, creamy, crackled, soft paste porce- lain is made. The figures used in decoration are birds and flowers, but outlined by heavy, dark lines. Consul Van Buren is of opinion that, at no distant day, Japan will be one of the foremost competitors in the pottery markets of the world, on account of the great variety and excellence of the clays, their proximity to the sea, the cheapness of labour, and the beauty and originality of the decorations. Already this important industry has been greatly stimulated by the foreign demand, and by the success of Japanese exhibitors at the Exhibitions of Vienna, Philadelphia, and Paris.

GOLD MINING.

The following report by Mr. Thomas Price to the Chairman of the Placerville Gold Quartz Company, Limited, dated San Francisco, April 16th, 1881, refers, in part, to Mr. A. G. Lock's paper on "Modern Gold Mining," read before the Society, January 19th last:—

"In answer to your favour of the 8th ult., on the subject of gold amalgamation as carried on at the Placerville Mill, I take very great pleasure in replying in detail.

"1st.—Description of mill:—The mill has twenty stamps, each stamp being of an average weight of 800 lbs., each battery of five stamps is furnished with a self-feeder. The self-feeders are connected with a large bin, having a capacity of three hundred tons of quartz; the floor of this bin is placed at an angle of 50 degrees, so that the quartz slides by gravity to the self feeders. The quartz is delivered from the mine by a self-acting tramway to this bin, the fine material passing through a grating, the coarser lumps remaining on the floor of the rock-breaker, both the fine and crushed material falling by gravity into the fore-mentioned bin, so that the ore passes from the mouth of the shaft into the battery, without the aid of any manual labour, with the exception of the labour in placing the large pieces of quartz into the rock-breaker. Cut 1 (enclosed herewith) will serve to show you how the self-feeder is attached, as well as the interior arrangement of the mortar. Cut 2 will show the kind of mortar in use—the gold one, of course, and not the silver one. The mortar has but one discharge, and that in front; the screens are made of thin slotted Russian iron, equal to 450 holes to the square inch; inside of each battery in front is a slip of silver copper plate, 8 in. in width by the total length of the battery. Immediately in front of the battery again is a large silver-plated copper-plate, equal to the total width of the mortar by 3 ft. in length, in front of which is placed again 20 ft. 18 in. sluice, the bottom of which is lined with silver-plated copper-plates, con- stantly kept in a bright condition. The tailings are now passed over what are known as Hendy's concentrators (there being one for each five stamp battery). Cut 3 (enclosed herewith) together with a printed description of the machine, explains itself. The tailings are now again passed over 20 ft. blanket sluices, and afterwards on a 50 ft. of coarse canvas sluices, or rather sluices lined with such material, and finally over 64 ft. of riffle sluices. The material caught on the concentrators and blankets is passed through an amalgamating pan, and settler, and agitator. Cuts 4, 5, and 6, and the accompanying printed description will explain this part of the operation. The material saved on the coarse canvas and riffle sluices are further concentrated in a Cornish buddle, as are also all the tailings from the amalgamating pan and settler. The quantity of quick- silver placed in the mortars or coffers is regulated by the appearance of the copper-plate in front of the battery;

of Arts. I had read this paper before, as I am a subscriber to the *Journal* of this Society for many years. (1st.) In the matter of 'gauge of gratings or screens.' The size of the screens should depend entirely upon the fineness of the gold in the quartz. If the gold should be diffused in a finely divided state through the quartz, it is evident that finer crushing must be had than if the gold were coarse. I have given the size of the perforations of our screens. (2nd.) All the protection to the mortar by having the dies rest upon a layer of sand has always been in use. We have not had any broken mortar as yet. The stamp-heads and the dies upon which they strike are of the same size; this we consider a protection to the mortar and stamp-head, that is the layer of sand under the dies. With such fine gold as we have to deal with at the Placerville, we could not expect much fine gold caught in this material. We rely upon our amalgamated copper-plates inside of the battery for this purpose, and I have no hesitation in stating that this is by far the best way to catch the maximum amount of gold. In the early days of gold mining in California, the stamps were used simply for the crushing of the ore, the amalgamation was conducted on the outside entirely, the only gold caught in the battery being coarse particles that could not pass through the screens. Experience has taught the mill men here that this latter method is not only more expensive, but by far less effective. I cannot agree with Mr. Lock when he states, 'I venture to assert that this system of putting mercury into the stamp coffers and using amalgamating plates, is radically wrong.' The difficulties that he speaks of, viz., the loss of quicksilver flouring, does not trouble us. I also claim that the particles of amalgam passing through the screens are caught either on the copper-plates in front, or on the Hendy concentrator, and if any escapes here, why we have the blankets, coarse canvas and riffle sluices, and finally the Cornish buddle.

"The last few weeks I have had some experience with the system designated as 'mercury riffles,' and mercury troughs, as fully described in Mr. Lock's paper. I had to examine a mine where they were in use, having been put in and erected by an experienced Australian mill man. I found the tailings containing an abnormal quantity of gold. The owners found it necessary to change this system to amalgamation on copper-plates inside the battery, with the usual outside

had occasion to examine a very l
quartz mines. At a very large n
large piles of tailings had accumul
piles I have had occasion to sampl
sented to be very rich, but, as
them sufficiently rich to pay for th
very popular thing for a superi
mine is good, plenty of gold in the
rebellious that it is impossible to s
such a mine have I had occasion t
sorrow of the stockholders, found c
character was due entirely to the
contained but little gold. I ha
stating that, with proper care and
I have described as in your mill a
effective for the quartz we have to
one described by Mr. Lock. Wha
on the mortar plates, copper-plate
concentrator, and the blankets a
boxes, and Cornish buddles w
endeavoured to cover the whole su
not, please let me know, and I wil
tional information I may have. I
guidance as soon as I have time t
of all parts of the mill, explaining

[This report has been commun
who has sent the following remark

The above report, by Mr. Thom
of, and in answer to, a list of que
addressed to all the gold-mining
purposes of my forthcoming book o
rence and Extraction."

I am pleased to be able to ta
publicly, to thank Mr. Price for hi
answering my questions, and I ea
good example will be followed by a
a similar list.

With regard to his comments on
the Society of Arts on the 19th o
not think the pages of the Society
place for a lengthy discussion; I
him, and all others interested in th
where the different systems adop
will be compared and fully discu
help, meantime, remarking that M
in the matter of loss of gold is s

r. Geo. J. Firmin states that in the Black Hills, ota, "they only obtain from 10 to 15 per cent. of gold," and that the general result of his inquiries ughout the country is, "that not more than 50 per t. of the assay value is recoved on the average."

ir are the United States singular in showing such a s of gold.

r. Edwin Gilpin, A.M., F.G.S., the Inspector of s for Nova Scotia, reports that since returns have collected, which enable him to ascertain results, 00 tons of pyrites, containing on an average 4 dwt. of gold, and 4 oz. 17 dwt. silver, with a of £10 10s. per ton, have "been thrown away; in words, over a million of dollars has been thrown brooks and swamps during the last 18 years." In er to me in March last, he characterises this loss as o the fact of "the chief idea being to pass as much sible through the mill, and turn the tailings into earest brook."

r. Walter A. Skidmore's "table of the losses sused in gold-mining countries" referred to above, s—

	Per cent.		Per cent.
edmont	35	Australia	25
ungary	50	Colorado	40
ili	66	California	27

have now lying before me a letter written in ruary last, by Mr. F. Guinness, warden and resident istrate of the Collingwood goldfields, Nelson, New and, in which he speaks of the melancholy fact that, ugh the inadequacy of the appliances and the want owledge how to extract the gold, the district, after ted trials, has been deserted, and gold-mining doned, "little or no gold being obtained, yet the yses of the quartz gave results of most hopeful ns, as much as 4½ ounces of gold to the ton having obtained from stone which Dr. Hector and myself out of the reef."

t to conclude, it appears to be owing to the nature e ore with which Mr. Price has to deal, rather to the efficacy of the appliances employed, that as so little loss, for we find that the Idaho Com-, Grass Valley, California, whose appliances are of most elaborate character, extending the great h of 270 feet from the centre of the stamp heads, about 27 per cent. of their gold, obtaining 47·90 rs, and losing in their tailings 18·67 dollars per f ore. ALFRED G. LOCK, F.R.G.S.]

ROPHONES AT THE PARIS ELECTRICAL EXHIBITION.

e Paris correspondent of the *Times* sends the folng description of the use made of the microphone e Electrical Exhibition, in order to give to numbers eople in the Exhibition the pleasure of listening, t after night, to the companies at the Opera at the Théâtre Français. Rooms have been fitted in the galleries, each with a number of pairs of phones. Two rooms are devoted to the Opera and to the Théâtre. The former is the more interest-, for there the actions and features of the performers of less importance. You enter the room in groups perhaps, ten at a time. Each one advances to a and seizes a pair of telephones, which he places to wo ears. Each of these is connected with a microe on the stage of the Opera, one to the right, other to the left of the prompter, and inclined rds the singers. The microphone to the right he prompter is connected with the telephone our right ear, the one to his left is coned with that at our left ear. Thus, while singer moves to right or left the sounds ine or diminish in the right or left ear; when they ase or recede the sounds increase or diminish in , and thus we are able to appreciate their movements, and it becomes difficult to believe that the performers on the stage are not directly behind the wall which we are facing. So soon as the telephones are applied to the ears the glorious voices of the finest singers in Paris are heard by us undiminished in purity, beauty, or force, by the strange means which have carried them to us over a distance of a mile. The orchestral accompaniment is somewhat weak, owing to the arrangement of the microphones. We can almost see the singer move about, putting expression into the movement and action; and in no part of the Opera-house can you hear with greater (I might also say with so great) clearness and power as in this tapestried room in the Palais d'Industrie.

THE PAPER MULBERRY TREE.

The United States Minister of Agriculture, in a recent report, calls attention to the largely increasing manufacture of cloth in China, Japan, and the Sandwich Islands, from the paper mulberry (*Broussonetia papyrifera*). In Tahiti and other South Pacific Islands, a species of cloth is manufactured from its bark, known as "Tappa" or "Kapa," and it is said that the finest and whitest cloth and mantles worn by the islanders and the principal people of Otaheite are made from the bark of this tree; it dyes readily, particularly in red, and takes a good colour. The following is the method employed by the native women of Otaheite in beating out the fibre. The cleansed fibres are spread out on plantain leaves to the length of about eleven or twelve yards, and these are placed on a regular and even surface of about a foot in breadth. Two or three layers are thus placed one upon another, great attention being paid to making the cloth of uniform thickness; if thinner in one place than another, a thicker piece is laid over this place when the next layer is laid down. The cloth is left to dry during the night, and a part of the moisture having evaporated, the several layers are found to adhere together, so that the whole mass may be lifted from the ground in one piece. It is then laid on a long smooth plank of wood prepared for the purpose, and beaten with a wooden instrument about a foot long and three inches square. Each of the four sides has longitudinal grooves of different degrees of fineness, the depth and width of those on one side being sufficient to receive a small pack-thread, the other sides being finer in a regular graduation, so that the grooves of the last would scarcely admit anything coarser than sewing silk. A long handle is attached, and the cloth is first beaten with its coarsest side, and spreads very fast under the strokes. It is then beaten with the other sides successively, and is then considered fit for use. Sometimes, however, it is made still thinner by beating it after it has been several times doubled with the finest side of the mallet, and it can thus be attenuated until it becomes as fine as muslin. Should the cloth break under this process, it is easily repaired by laying on a piece of bark, which is made to adhere by means of a glutinous substance made from the arrowroot, and this is done with such nicety that the break can scarcely be detected. In other islands the bark is kept wet and scraped with sharp-edged shells. It is said that the King of the Friendly Islands had a piece made which was 120 feet wide and two miles long. In Japan a species of cloth is made from paper derived from this tree. It is cut into thin strips, which are twisted together and spooled, to be used in the woof of the fabric, while the warp is composed of silk or hemp. About 250 pieces only are manufactured at the principal manufacturing place. The paper mulberry grows everywhere in Japan, and is a valuable tree, as furnishing the bast from which a large portion of the Japanese paper is made; the plants are reproduced in quantity by sub-dividing the roots, and in two or three

are produced are made of bamboo, split into very thin sticks, and united in parallel lines by silk or hemp threads, so as to form a kind of mat. This is laid upon a wooden frame, and the apparatus dipped into the vat, raised and shaken, so as to spread the pulp evenly, after which the cover is first removed, then the bamboo couch, with the sheet of paper. When a number of sheets have been thus prepared, they are pressed to exclude the water, and afterwards spread out with a brush upon boards and allowed to dry. The sheets are only about two feet in length, but sometimes sheets ten feet long are produced.

GENERAL NOTES.

Technical Instruction.—A Royal Commission, consisting of Mr. Bernard Samuelson, M.P., F.R.S., Mr. Henry Enfield Roscoe, D.C.L., F.R.S., Mr. Philip Magnus, Mr. John Slagg, M.P., Mr. Swire Smith, and Mr. William Woodall, M.P., has been appointed "to inquire into the instruction of the industrial classes of certain foreign countries in technical and other subjects, for the purpose of comparison with that of the corresponding classes in this country; and into the influence of such instruction on manufacturing and other industries at home and abroad." Three is to be a quorum. The Commission has the ordinary powers.

Agricultural Returns for 1881.—The Statistical and Commercial Department of the Board of Trade have issued a summary of the returns collected on the 4th of June last, which shows the extent of land in Great Britain under wheat to be 2,806,057 acres, or 103,381 acres less than in 1880; barley, 2,442,405 acres, or 25,036 acres less than in 1880; oats, 2,901,135 acres, or an increase of 104,230 acres; potatoes, 579,431 acres, an increase of 28,499 acres over 1880; and hops, 64,128 acres, or a decrease of 1,577 acres. The total number of live stock in Great Britain on the same day is given as—Cattle, 5,911,524; sheep and lambs, 24,582,154; pigs, 2,048,034.

Adelaide International Exhibition.—Particulars of this Exhibition, which was opened on July 31st, by the Governor, have been received. The Exhibition is reported to have proved highly successful, the demands for space having been so numerous, that it was found necessary to

ourselves able to agree on certain p
papers were prepared by twenty or th
inspectors, and we elicited from the
criticism. Having received these rep
report, and agreed, further, that t
thoroughly sifted, and the details w
mittee, consisting of Sir F. Sandford
Cumin, the three chiefs of the Depar
Mr. Warburton, who had great experi
of smaller schools, Mr. Sharpe, as insp
and Mr. Fitch, for his connection wit
Over this committee Mr. Mundella pre
was ended, it was yet further sifted, b
enlarged committee, including Mr.
three other inspectors. This was p
Spencer, and the result is the docume
of the House.

Population of Austria.—The follo
of the population of the several pr
Hungarian portion of the Austria
from the report of the Central St
for taking the census last Decemb
2,329,021; Upper Austria, 760,879;
Styria, 1,212,367; Carinthia, 348,67
Trieste, Istria, &c., 650,532; Tyro
berg, 107,364; Bohemia, 5,557,134;
Silesia, 565,772; Galicia, 5,653,170;
Dalmatia, 474,489; total for the Au
22,130,684. This gives a total inc
years of 1,734,054, or 8·5 per cent.
result as compared with the Hunga
the increase for the ten years—1
1·24 per cent. The total population
garian Empire last December, was
increase for the decade of 1,925,450, to
provinces had contributed only 191,39
rate of increase in the provinces of th
the monarchy averaged only ·772 pe
averaged during the last five years 1
more than one-third higher. The po
towns in the Austrian provinces last D
Vienna, 726,105; Prague, 162,318
Lemberg, 110,250; Gratz, 97,726; I
60,226; Czernowitz, 45,600; Linz, 41,

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F THE SOCIETY OF ARTS.

[o. 1,503. VOL. XXIX.

Y, SEPTEMBER 9, 1881.

for the Society should be addressed to the Secretary
n-street, Adelphi, London, W.C.

NOTICES.

FURNITURE EXHIBITION.

:ion of Works of Art Applied to connection with the Exhibition of ie Royal Albert Hall, will be closed he 10th inst.

of the Judges appointed by the :ommend the awards of silver and to the designers and art workmen exhibited in the Exhibition, has and will be laid before the Council eeting after the recess. The report Messrs. George Godwin, F.R.S.; st, M.P.; Edward J. Poynter, R.A.;)le, hon. sec.

INGS OF THE SOCIETY.

CANTOR LECTURES.

ART OF LACE-MAKING.

By Alan S. Cole.

)ELIVERED MONDAY, APRIL 4, 1881.

Early forms of twisted, plaited, and s. Ornamental borders of costumes. iws. Venetian books of patterns for nd lace. Flanders a centre of linen pe. Spanish and French importations Effect of production of machine- on production of hand-made lace.

taking to deliver a course of Cantor "The Art of Lace-making," in th a gratifying invitation from the e Society of Arts, I am sensible bility I incur. I cannot, however, n your indulgence, since the position ew to me. An experienced and able at once how to engage the sympathy :e. He leads them over difficult ıg the difficulties interesting, just e does, who shows you the way up a)ugh forest and rocky lands, across over snow fields. The tracing of a :-making is not, however, likely to be beset with many difficulties. It covers a considerable space of time—over three hundred years—and involves the consideration, as all history does, of a number of circumstances. A tolerably straight course must, if possible, be adhered to, so that we may not stray off into tempting by-paths. Many works have been written and published upon lace-making, and I can hardly hope to bring to light many facts or reflections which have not been previously placed before the public. If I am successful in adding anything which may assist a true view of the development of lace-making I shall be fortunate.

II. Everyone present, I presume, knows what lace is, in the ordinary and modern sense of the word. The shop-windows of linendrapers are filled with it. It is universally worn. About twice a week we may read in our newspapers that the lace trade is full of activity at Nottingham, in Belgium, in France, and elsewhere. If we go abroad, we see lace much like that we have left at home. Sometimes the lace trade is reported to be less vigorous than it was, sometimes it is more. A fair demand is maintained for Coraline and Vermicelli laces, whilst Bobbin, Bretonne, and Mechlin sell pretty well at "late" prices. The market, however, is dull on the whole, and there is no business in Valenciennes. This sort of intelligence usually comes to us at breakfast time, but it is not of the exciting character of some news which spoils our meal. After breakfast, if we happen to have absorbed the intelligence about the lace market, we may go out expecting to find symptoms of it in the shops. Not at all, however. A constant supply of cheap laces is to be purchased.

III. Now, I think that it would take some of us by surprise were an announcement to be made that Parliament had passed a Bill ordering that no lace wider than two inches was henceforth to be worn. What a disturbance this would create amongst lace workers and lace wearers! It would be almost more exciting than many recent points of domestic news. Judging from past events in similar circumstances, the ingenuity of people would be sharpened into all sorts of evasions of the law, both numerous and humorous.

IV. In the 14th, 15th, and 16th centuries, laws regulating costume were in force, and a result of them has been a number of entertaining anecdotes about evasions of them—smuggling, and so forth. An incident in the history of these laws was the imperturbability with which fashion displayed itself to be stronger than the laws. In spite of regulations and edicts, which one might suppose would have prevented people from teaching one another their fashions, and from interchanging their national productions and manufactures, this teaching and interchanging went on generally in an overt way, but still persistently forming and virtually ruling what is called fashion. At the outset of lace-making, difficulties like those just mentioned were imposed upon its development. Nevertheless, fashion has stimulated lace-making, and has raised lace work to an eminence in public favour, the hold upon which modern machinery is certainly striving to perpetuate, by widely disseminating lace of a special class.

V. The plan which I have adopted for my lectures is, roughly, as follows:—First, I propose to make a few observations upon the ability to twist, plait,

regards lace. I heard a good deal about lace when I had the honour of serving on a committee which was formed to promote an Exhibition of Ancient Lace for the International Exhibition at South Kensington, in 1874. But when I came to be presented to some of the most splendid productions of the art, I found that hearsay did not give me much assistance in making myself really acquainted with these works. It was necessary to do more than express satisfaction at a beautiful piece of work, or to allow oneself to be carried away with enthusiasm over the interesting fact that some Venetian Dogeress had actually made a certain length of vandykes. Throughout the collection shown at the Exhibition there was an immense variety of pattern and of workmanship. It seemed to me that I should be more likely to understand this if I applied myself to a careful examination of a few of the important specimens. Accordingly, a pocket magnifying-glass became a necessity, and through its help I began to arrive at some sort of classification of laces by stitches. As soon as I had satisfied myself as to the marked difference between needle-made and pillow-made lace, I began to study the catalogue and the descriptions printed in it. I confess to having been surprised, and inclined to doubt my eyesight, at the frequency with which my opinion clashed with the descriptions. It seemed as though tradition was more often than not exactly the reverse of personal experience. Some of the best traditions were only credible, subject to important "if's;" others, however, seemed to gain in historic value as they harmonised themselves with results of actual observations. A sense of gratitude to the spirit which moved me to closely examine specimens, and not to rely too much upon traditions and so-called authentic r ecords, required me to give you this little account of my experience in studying lace.

VII. From examining lace-work, with all the minute twistings, plaitings, and loopings of fine

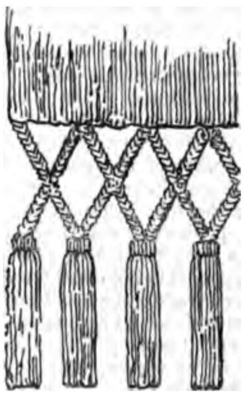
some sorts of lace-making—has a
sewing done by tailor birds. I
temptation of quoting a passage
book, which tells us how the tail
hanging nest:—

"The bird chooses a convenient
which hangs at the end of a slender
row of holes along the edge, using it
manner that a shoemaker uses his a
ments being very similar to each oth
not in material. These holes are
and in some cases there are so man
bird seems to have found some spe
making them just as a boy who has
havoc on every piece of wood he c
the holes are completed, the bird
thread, which is a long fibre from so
much longer than is needed for
performs. Having found its thr
tailor begins to pass it through the
sides of the leaf towards each othe
kind of hollow cone, the point down
a single leaf is used for this purpose
bird cannot find one that is suffici
two together, or even fetches another
with the fibre."

IX. You will, I hope, pardon m
sion from the point we were con
man's ability in twisting and
I think we may take it that this
sort of spontaneous invention.
the development of certain nat
the fingers. Therefore, where th
fingers, and a governing intelli
to plait, twist, and loop threads
One might not expect to find t
restricted to one nation, or to
world's history. Still, certain con
especially favour the exhibition
and plaiting ability, and perha
such conditions is the exist
quantities of articles like flax
of all kinds.

ıds of twine are stretched in parallel ›ut half an inch from each other, from ·ont of the frame of the seat. Similar ı also stretched from side to side. Thus square meshed foundation is made. :e intertwisted—diagonally across the ›ws of some eight or twelve strings or so the seat, not unlike our modern cane ›nstructed. This sort of plaiting and ıg, however, cannot be said to have pretence, and is not so germane to orna- ɾk we call lace, as are fringed borders of sculptured upon Assyrian monoliths, ne of Assur-nazir-Pal, about 800 B.C. ..) The lines forming a trellis pattern in

FIG. 1.



Assyrian border, 800 B.C.

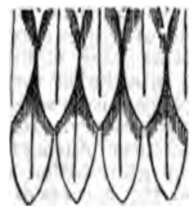
part of these borders appear to consist plaited cords, very similar in their › that which we see upon fringed borders ɑ carpets now in the market, or to ɪther whip thongs. On the mantle of the trellis pattern is rather more than those on the dresses of the attend- ɜ design is, however, quite primitive.

our English Bible lace is frequently ., but its meaning must be qualified by ·e due to the use of such a word in s time. It is pretty evident that the s used it to indicate a small cord, since decoration would be more commonly ı that time as "purls," "points," or ks."

f lace amongst the Greeks we seem to have ce. Upon the well-known red and black ıll kinds of figures, clad in costumes which :ed with ornamental patterns, but these ɛed upon, woven into, or embroidered upon . They were not lace. Many centuries efore a marked and elaborately orna- aracter infused itself into twisted, plaited, thread work. During such a period the f ornamenting borders of costume and existed and underwent a few phases: ıstance, in the Elgin marbles, where ɜdges appear along the loose flowing resses.

:t is recorded that our "general parents" ırden of Eden, wore aprons of leaves, overlapping one another, an arrangement subsequently modified for their scale armour by Greeks and Romans. (See Fig. 2.) The scales of

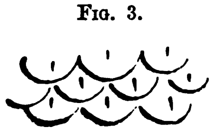
FIG. 2.



Overlapping leaves of armour.

the armour were of leaf and billet forms, as were the edges of the under skirt and sleeves. (See

FIG. 3.



Overlapping scales of armour.

Fig. 3.) If you want to see an attractive example of this method of varying the line of the edge, the costume of Mr. Irving, as *Synorix*, in Mr. Tennyson's drama of "The Cup," presents you with one. Along the borders of Mediæval costume, this custom of indenting the border was perpetuated. (See Fig. 4.) The French word, "dentelle," is

FIG. 4.

Cut, scalloped edge.

evidently derived from the tooth-shape of such scallops.

XIV. To continue, however, our rapid glimpse of fashion in patterns for bordering costumes and in decorative accessories to dress, which seems to have led up to lace. Mosaics, dating from the 6th century after Christ, preserved in churches at Ravenna, give us representations of early Christian saints, Cecilia, Crispina, Lucia, and others, attached to whose white head-dresses are fringes. Besides these, there are resplendent mosaics of the Empress Theodora and her ladies in waiting, all arrayed in sumptuous apparel, some of which is ornamented with dentations, and others with wavy and undulating borders. In 1078, Benedetto Antelami, recording the fashion of his time, wrought a patterned edging to the robe of the Virgin, who appears in a composition he carved in stone for an altar or panel at Parma. A border, consisting of a series of holes, no doubt cut and worked upon

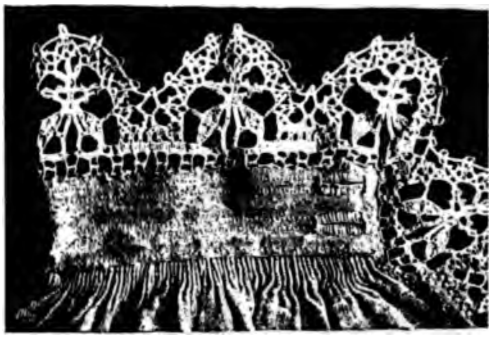
family, decorated the borders of the robes of the figures. But in mentioning these Italian instances of the fashion in borders of dresses, it must not be supposed that similar fashions had not also penetrated to other European countries.

XV. In Edward IV.'s time, in England,

> "Cut werke was greate in Court and towns,
> Both in men's hoddes and also in their gowns."

but this "cut werke" is not cut work embroidery as we know it. It was the cutting out into shapes, the dentation or scalloping of the borders of stuff "hoddes" and gowns, as we find it with the Romans. (See Fig. 4.) This kind of ornamentation undoubtedly influenced the shapes in which most of the first laces were to be inserted, and we trace such shapes in "points" of the 16th century, an example of which I will show you (Fig. 5). Chaucer, too, in his Parson's tale,

FIG. 5.



Cuff trimmed with lace-work in "points," or Vandykes. Late 16th century.

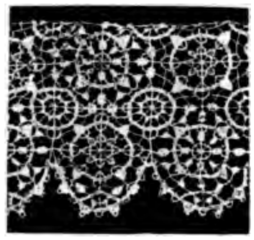
gives us an insight into fashions of dress, when he deprecates "the superfluitee of clothing, which maketh it so dere to the harme of peple not only

In the 14th and 16th centu
Republic was in the glory o
relations with all European c
virtually one of the most prosp
of European centres. Her
"Flanders galleys" were well
other trading vessels on the coa
and Northern Europe. The
galleys" marks in a way the cons
Venice had with Flanders. The
lie along the quays of the delig
Bruges, and there discharge the
ever much during four hundred
tile prestige of Bruges may ha
are now signs that the use of t
Belgian Liverpool is being consid
all this Northern trafficking four l
much trade with Oriental countr
The wealth and taste of Venic
and luxuries of costumes, silk
clothes, velvets, and much else f
extravagant indulgence of wea
their use of these costly mat
Council of the Republic to pas
from time to time, prohibiting
of such things. Venice, howe
understood to have been singu
for similar laws were in force i
These laws, principally aimed
the circumstances of the ti
influence in educing artistic i
think that in regard especially
Venice, they have an important
of the 17th century, describing
a pre-eminence that Veneti
Italian women, enjoyed for the
ness of their linen, as well as fo
ing and embroidering. An old
runs, "La camicia preme assai
or "The shirt before the coat."
coloured decorations used by
costumes were, to a considera
under the ban of sumptuary

ivourite occupation with women in of Europe. The making of simple ted white thread edgings to collars be readily taken up by the thread w occupation was thus provided, followed by peasants in their homes , or by sailors in their leisure time In convents, too, where a gentle ering has always found favour, the thread and linen ornamentation Embroidering linen became so designers compiled and published s, which, as a rule, were dedicated courteous language of the time to e," who were addressed by the rs in their dissertations on the gentle, delicate, and magnanimous, ful readers.

r three antiquaries have paid close e history of these pattern-books. honour of first publication for or Italy, and others for Germany. pattern-books came to England as ng over many of these rare books e way, Signor Oncagnia, of Venice, blished some admirable reproduc- le), I find that with none of them ctions supplied of how the different for which there are patterns, are It is agreed, I think, that of ks that by Alessandro Pagannino, 527, is one of the earliest. It is t Book of Embroidery," as well as " oneself in diverse methods, uses, broidery never before attempted or hich methods the willing reader may Putting aside the author's ascrip- f the credit of having published the the subject, it is not unlikely that g of shirts, socks, cuffs, and gloves fore the book appeared. Be this er patterns nor titles indicate lace ok by Tagliente, published in 1531, eration of stitches, such as "punto a darning stitch), "punto sopra titch, perhaps), "punto ciprioto" "punto croceato" (perhaps a stitch ked needle, like crochet), "punto in ght be "punto in aria," or needle- nto fa su la rete" (which would be a species of canvas), "punto dis- n thread-work), and others. The aere," or point in the air, should cularly. But the pattern entitled " is not specially distinguished as with the exception of this doubtful " all the embroidery indicated is u have seen, to be done upon a stuff. The materials named to ks of various colours, gold and and other sorts of threads; the implements depicted are com- ncils, scissors, a pad for pouncing hanks of threads, but there are no cushions. The designs are to be umes and hangings, and besides own, consist of scrolls, arabesques, owers, foliage, herbs, and grasses; lace would be concerned, involve f work as none but practised lace makers would be able to overcome. Twenty years later we have special geometric patterns workable by lace makers, who were at the threshold, so to speak, of the practice of their art. (See Fig. 6.)

FIG. 6.



Part of a border of needle-point lace, geometric design. About 1550.

At this time, about 1550, the "punto gropposi" (knotted work) is named. The designs, too, of the same time, for "punto in aria," are clearly geometric lace designs.

XVIII. Monsieur Aubry, member of the jury appointed to make awards of prizes to lace manufacturers, who exhibited specimens at the Great Exhibition in 1851, is one of the first of modern writers on the art of lace-making. For the ground-work of her "History of Lace," I find that the late Mrs. Bury Palliser, as all students of this subject must be, is indebted to him. M. Aubry says that Italy and Belgium dispute the honour of the invention of lace-making. Without attempting to settle the dispute, he says that we can easily imagine that the fabrication of lace in each of these countries was quite different, and thus having drawn upon our imagination, Mons. Aubry is assured enough to say that if Venice is the cradle of needle-point laces, at Brussels it is certain that the first pillow and bobbin-made laces were produced. After examining the evidence, which he brings forward to support his statement, as well as considering remarks made by Mons. Seguin in his "History of Lace," I have formed the opinion that so distinctive a method of using threads as that involved in ornamental lace-making has not a contemporary double origin; and in a later lecture I hope to show you a series of specimens which appear to indicate how elaboration of plaiting, twisting, and looping white threads developed according to the demands made upon workmen's ingenuity by the designers of patterns. The workmen's ingenuity developed two distinct classes of work, the one needle-point lace, the other pillow-made lace. The former is, undoubtedly, an offspring of embroidery, just as the latter is of fringes or twisted cords. Both, however, in respect of artistic pretence, are traceable to the pattern-books. We have noticed the appearance of "punto in aria" or needle-point lace, and that of "punto gropposi" or knotted work. A modification of the "punto gropposi" is the "merletti a piombini." (See Fig. 7, p. 774). In this specimen you would see that plaiting is used. There are no knottings, and few simple twistings. The first patterns for both plaiting and needle-point work then appear to have been made in

Venice in the 16th century, say about 1560, and thus M. Aubry's supposed double origin of lace vanishes, that is, if my statement be correct.

Fig. 7.

Plaited and twisted thread-work known as "Merletti a Piombini." About 1560.

XIX. No sooner, however, are novelties produced, than imitations quickly follow. The twisted and plaited thread-work was by some more easily done than needle-point work by others; and the Flemish, the chief spinners and weavers of thread, very naturally I think, were the first imitators of Venetian patterns of this sort of work, which was plaited on cushions. We have already seen that commercial relations long existed between Venice and Flanders. It had been chiefly carried on by ships, and this, of course, in respect of heavier merchandise, but in the 15th and 16th centuries an overland route *via* Augsburg, Cologne, and Bruges, was also used, probably for lighter wares. Copies of pattern-books, and dentated and scalloped trimmings, were no doubt included amongst these lighter wares. It is not, therefore, surprising to find pattern-books, evident imitations of Venetian books, springing into publication along the route overland. At Augsburg and Cologne, and as far north as Antwerp, we know such books were issued. At this last-named city, possibly about 1540, one of the first of the foreign imitations of Venetian books of patterns was produced. It is called "A New Treatise; as concerning the excellency of Needlework, Spanish Stitch, Weaving in the Frame, very necessary to all who desire perfect knowledge of Seamstry, Quilting, and Broidering work, containing 138 plates."

XX. The mention of "Spanish stitch" makes one almost expect to find Spanish books on needlework. But, curiously enough, no such books corresponding to the Italian, German, Flemish, French, and English pattern-books have been found or known to have been published in Spain. Spanish stitch is now supposed to have been a black silk embroidery upon linen, and its use is assigned to the early 17th century. This is not a lace, however. Of the supposed manufacture of artistic lace in Spain, it may be convenient for me now to speak. It will, no doubt, be a matter of surprise to many, who are so accustomed to hear of and see what they are told in "Spanish point," if I say that Spain cannot be identified with the making of ornamental and fine white thread lace, as are Italy, Flanders, and France. Señor Riaño, an authority in these matters, writes that, "The most important ordinances relating to Spanish industries are those published at Toledo and Seville in the 15th and 16th centuries, and at Granada in the 16th and 17th centuries, and in none of them do we find lace even alluded to." A Friar, Marc de Campos, 1592, preaches, "I will nc and fail to mention the time lost these l the manufacture of 'cadenetas,' a worl combined with silver; this extravaganc reached such a point, that hundreds an of ducats were spent in this work, wh destroying the eyesight, wasting awa and rendering consumptive the women it, and preventing them from spendin with more advantage to their souls, of thread and years of time were wa unsatisfactory a result." Señor Riañ argue from this that the Friar adopted " as a term meaning lace-work. But, fur says "cadenetas" is chain stitch. Bearin that the fashion of the 16th century di self towards "points," and "dentel bands of insertion of lace-work, it might haps more likely that the Friar would sumed such adornments with the fire of —naming them by their proper n "puntas," "randa," and "entredos." may, no doubt, have been inveighing sinful extravagance in the use of so embroidery; I do not think, however, safely rely upon what would be a misap as proof that Spain made lace; that she e is well-known. Whilst the female po family embroidered, Cervantes, it is much of his "Don Quixote."

XXI. Ornaments made of plaited gold and silver threads, much in th some lace was made, were producec during the 17th century. Mention to be found in the ordinances of Towards the end of the century, Na author of a work published in Barcel by M. Aubry, writes, that "edgings of gold, silver, silk, thread, and alo made at Barcelona with greater perf in Flanders." In the 16th century F part of the Spanish dominions. S always spoken of as Spanish Flande Spain was indebted for a quantity o tured and artistic goods, linen and la I conclude, therefore, that the Barc making was more or less an imitat which had pre-existed in Spanish Apart from this, the gold and silver lace Venice, Lucca, and Genoa, preceded Flanders. It appears to me that Spa in the field of artistic lace-making t Flanders, and France. As a great com wealthy power, Spain, I think, in the 16t centuries, imported the greater port fantastic and fashionable luxuries she Even the celebrity of the gold "Point d' is due, I fancy, more to the use of by Spanish grandees, than to the pro Spain of a gold lace, better in design, in ship, and quality, than that from Italy a The manufactories at Paris and Lyons force, supplying the fashionable w gold lace in the 17th century. "Point d'Espagne" was, I think, a name given to gold lace by French ma interesting to note that Beckmann in hi of Inventions," says that it was a fash the name of Spanish to all kinds o

panish flies, Spanish wax, Spanish green, rass, Spanish seed, and others. This sure establishes the value set upon the on or title "Spanish," and, at least, that the custom of Spaniards was much y other nations. In concluding these ns as to claims that Spain may have for sidered an early maker of artistic lace, I te the following passage from Señor which greatly affects the value of what herwise be a fact of importance contained Palliser's "History of Lace":—

withstanding the opinion of so competent an as Mrs. Palliser, I doubt the statement, find-idence to support it, that thread lace of a very tistic kind was ever made in Spain or exported icle of commerce during early times. The lace h Mrs. Palliser mentions to prove this, as exist-ranada, a gift of Ferdinand and Isabella in the tury, is of Flemish lace of the 17th century."

. Of France and her connection with early king, there is not much at present to be said. ident that a great deal of foreign lace, rom Flanders and Venice, were imported nce, and that all sorts of prohibitions were prevent the expenditure of the French sign goods, and so, if possible, to encourage ufacturers to make articles for home con-n; but the importations went on, and was at this time unable to make laces to with those from Italy and Flanders. The s of commercial dictionaries and encyclo-Diderot, Savary, Roland de la Platiere, and writing in the 18th century, give the names ificant little primitive twistings and plait-e "gueuse" "mignonette," and "cam- These bear about as much relation to fine aces as a flint instrument does to a Cellini's andle. Taste in manufacturing lace in was not evoked until Frederic Vinciolo came about the end of the 16th century, and the Court of Henry IV. with varieties e thread work, including the geometric f Venice. But even Vinciolo's nfluence was and only laid the seeds of a condition in France, which enabled Colbert forty ter to induce Venetian lace designers and n to come over to France and to help in blishment of a number of places where uld be regularly made. Many of the earest to Flanders were judiciously chosen new lace establishments. But the chief French towns subsequently most famous r its lace was Alençon in Normandy. Of ence of Alençon we shall hear more in the f our investigations of needle-point lace

I. Of incidents concerning workpeople en-n the manufacture of lace, we have little information. History is almost silent in of guilds, or bodies of lacemakers (if ere such) in the 16th century. Venetian might be expected to reveal some light is; but at present the search has not been itful. Documents exist to show that a dy, Bianca Capello, was able to monopolise king of certain laces for her own use, in nd that in 1582 Juan Isepo worked a l collar, very likely of Reticella work, for Morosoni di Francesco. A note is given in a pamphlet by Signor G. M. de Gheltof, of the foundation of a school of 120 lacemakers at Venice, by Morosina Morosini, in the 17th century.

XXIV. Valuable State records, from which some information might probably have been obtained about the Flemish lace trade, were burnt in a fire at Brussels in the year 1731. Private papers of nunneries in Italy and Flanders would probably be an interesting source to examine. Evidence, such as it is, points to lace-making having been at first an occupation of individual peasants, rather than of organised bodies of persons. Nuns in convents no doubt produced a good deal of lace, as well as children in schools; and by Italian trimming makers and French guilds of "passementiers," probably much lace of a primitive kind was made. Lace of later periods, that is, from the middle of the 17th century onwards, can generally be identified with centres of manufacture, like Valenciennes, Mechlin, Brussels, Alençon, Honiton, &c. But of the earlier laces, excepting those done according to Venetian patterns, we have not much to rely upon for guidance.

XXV. The 16th century Italian patterns are sometimes named "punto Famenghi," "punto Genovese," and "punto Francesco;" but there is little variety in the style of the patterns, so that the names, even if they meant more than the celebrated "Point d'Espagne," do not give us new clues as to other centres of manufacture if they existed. These names were apparently pattern-makers' names for styles, intended to catch the fancy of the different people to whom they were dedicated, and may have been made in various towns in Italy, such as Rome, Venice, Genoa, Milan, Piacenza, and elsewhere. I am afraid, therefore, that much of the classification of early lace has to be somewhat vague.

XXVI. An elaborate design, for instance, is hardly likely to have been worked out by humbly trained peasant hands; it is more likely to have emanated from some place where workmen and women were employed for the purpose of lace-making, and where they had access to good patterns, plenty of materials, and so forth. Such conditions existed probably also in Italian and Flemish convents. On the other hand, simple patterns would, from the ease with which they could be executed, recommend themselves to makers of the less important laces, whose opera-tions would have a tendency to become restricted to the repetition or modification of such simple designs, the sale of which would no doubt take place amongst the villagers, or else be promoted by some *Autolycus*, and such hawkers of wares, at fairs and markets.

XXVII. The excellence of much of the early lace is perhaps due in a great degree to the good taste of the wealthy, who bought and wore the work. Demand ruled supply, whereas now-a-days, supply seems to rule demand so far as beauty of design and quality of workmanship goes. There are few Mecænases now. The recommendation of the salesman is a chief moulder of public taste. The salesmen in turn regulate the style and quality of the goods to be made, according to their opinion of public taste and fashion. Such rela-tions do not seem to have existed when the great Alençon factories were established. For the

wealthy lace wearers, then, at that time, the number of lace workers was insignificant as compared with the number now. One might say that lace wearers could be counted by the thousand, whilst those not wearing laces were the millions. This is now almost reversed. The millions now wear it, or something like it. Louis XIV. and Colbert determined that French taste in lace should be good, and virtually took into their own hands the supply of lace to the country. From Alençon were sent out admirable patterns and exquisite workmanship, which were readily accepted by lace fanciers. Brussels unquestionably adopted styles of Alençon designs for her pillow laces, which in time superseded French needle-point laces. Our English pillow-lace workers adopted some of the Brussels patterns and some of the Mechlin; but English taste was easily gratified by less skilfully arranged patterns, and found sufficient pleasure in the peasant laces of Buckinghamshire and Devonshire. It is these patterns that a good deal of the machine-made lace imitates, though within the last three or four years there has been a marked phase of other more ambitious imitation in the machine-lace trade. Something akin to the rich patterns of ancient hand-made lace is now made by the machine, and to the majority this substitution of machine-made for hand-made goods is satisfactory. As a rule the difference between machine and hand-made lace is not detected by the many. If there is a difference, to some it is that machine-made lace, from some points of view, is the more wonderful and more to be prized of the two sorts of work. Setting aside any prejudices one may have, and reviewing the variety of forms wrought years ago, we may consider some of the circumstances of the production of laces. Sometimes laces were made in dim and dark cellars, so that the soft fragile threads should retain their elasticity, and not become brittle. A ray of light alone was allowed to fall upon the workwoman's cushion. What an expense of eyesight and health must then have taken place. Compare truly costly works produced in such circumstances, with the low-priced repetitions done in taut wiry cotton threads which grow with precise monotony of pattern in the bustle and clatter of machinery, at the expense of iron and steam, and one is perhaps inclined to be glad at the release of human labour from penalties like those which formerly accompanied lace-making. I do not think anyone can well say what may succeed to the mechanically devised and produced materials now called lace? They seem to satisfy present demand and to reflect the taste and ability of the age. Is it vain to hope for a revival of hand-made works? Is the time to arrive when machinery shall have exhausted itself in its endeavours to infuse into its productions the quality of hand-work—or has a period commenced when people shall be contented with mechanical instead of manual art? and so from this possibly pass on to a condition of indifference to fine artistic works of handicraft, which not many years since were reported to have been pronounced by a philosopher and leader of opinion to be but the rubbish of human labour.

XXVIII. In my next lecture I hope to deal with the various needle-point laces, and besides the examples shown on the screen there will be a few fine specimens of lace, and some pho[...]
I must not conclude my remarks thi[...] without acknowledging the advantage[...] both you and I have received from [...] Cunliffe-Owen, director of the South K[...] Museum, who kindly caused many of [...] parencies of lace to be made, as well a[...] William Drake and Mr. Edmund Dre[...] lent specimens, some of which have been [...] and others photographed, by Sergeant [...] R.E., the able assistant of my friend [...] Abney, R.E., F.R.S.

MISCELLANEOUS.

NATIONAL TRAINING SCHOOL FO[R MUSIC].

The fourth general report, dated Easter, [...] just been issued, and the following is an abs[tract of its] contents :—

The Committee of Management have the [...] submit, for the information of the founders [...] ships and subscribers generally, the followin[g ...] the condition and proceedings of the school [...] past year.

Scholars and Private Students.—The body [...] has undergone some slight changes durin[g ...] *e.g.* seven scholars have resigned their scholar[ships ...] four to devote themselves entirely to their [...] one in order to prosecute his studies in Ital[y ...] failing health, and one has forfeited her sch[olarship by] irregularity of attendance, and by failure to c[omply with] the rules of the school. Three of these vaca[nt scholar]ships have been conferred on new scholars, [...] has been cancelled by the founders for want [...] continue it, and three are still vacant.

The number of scholarships is now, ther[e...] which 23 are held by males, 66 by females, [...] as has been already said, are vacant.

Arrangements having been made for the a[...] private students for periods of not less tha[n ...] on payment of £40 a year in advance, there [...] admitted of that class during the year now [...] females and four males. Such students are [...] the same privileges, are taught by the same [...] in the same classes, and are subject to [...] discipline as the scholars. Previous to adm[ission ...] musical abilities are tested by examination.

Attendance, Conduct, and Studies.—The at[tendance of] the scholars, save in cases of sickness, cont[...] regular and punctual; and their general b[ehaviour ...] very satisfactory. The instruments and s[...] study are, of course, substantially the sa[me as they] were at the time of the issue of the last r[eport ...] present 57 students are cultivating the pi[ano as their] principal subject of study; 32, singing; 14, [...] five, the organ; and one, the flute. The pi[...] singing, violin, organ, clarionet, or violoncell[o ...] second studies; while the vocalists, viol[...] organists, are compelled to study the pian[o ...] students continue to attend the harmony [...] classes, the vocalists attend the Italian clas[s ...] those who are competent for it have inst[ruction in] counterpoint and composition. An orchestr[a has] been established and placed under the directi[on of Mr.] F. H. Cowen. It embraces all those student[s ...] upon orchestral instruments, and meets for [...] hours per week. During certain terms [...]

dical concerts in which all the scholars in turn take

-me of Study, and Examinations.—The period aced by the present report includes three school s, viz., the Midsummer and Christmas terms of , and the Easter term of 1881. At the end of the mmer term the fourth annual examination of the lars took place in the West Theatre of the Royal t Hall. The professional examiners included Sir el Costa, Sir Julius Benedict, Sir George y, and Mr. Charles Hallé. Mr. Hullah and essor Ella being too ill to attend, the Com- ee of Management, at the suggestion of Dr. van, the principal of the school, invited Messrs. Goldschmidt and Henry Leslie to join the Board xaminers, and these gentlemen courteously accepted invitation. Owing to some unfortunate want of rstanding between the authorities of the school and xaminers, the examination, though going on for days, was not formally conducted; and in a report h the examiners made to H.R.H. the Prince of es, it was admitted that the examination which had n held was not an examination in the strict sense of word, and neither fair nor advantageous to master pil. Under these circumstances it was arranged another examination of a more strict, formal, and hing character should be held at the earliest con- ence of the examiners.

he ordinary terminal examination for the Christmas was held in the school on Saturday, Monday, and sday, the 18th, 20th, and 21st days of December. as conducted by Drs. Sullivan and Stainer, who had ssistance of the Board of Professors and of several professors. It extended to the principal subjects dy, to modulation, sight reading, figured bass ing, playing from vocal score, playing from full s, and transposing song accompaniments. On this mination Dr. Stainer reports:—"The examination his occasion was directed to a class of subjects in h the scholars had not been hitherto tested, namely, position at sight, playing from figured bass, from score, &c. The results showed that a consider- amount of proficiency had been attained by the rity of students, although the novelty of the test ed so much nervousness, especially among the ger pupils, that the task of the examiners was easy. In all examinations on these special sub- it will be found that players on polyphonic ruments such as the piano and organ, attain highest standard, players on string instruments e degree of proficiency, whilst vocalists rarely ber them to any marked extent. In the exami- on of the principal studies of the scholars, results were favourable. The signs of improvement xecution and taste, anxiously watched for by the niners, were not deficient, although some few pupils red that they never could rise above a medium dard of proficiency, owing to their want of natural t.

owards the end of the Easter term 1881, arrange- ts were made at the request of H.R.H. the Prince Wales, for holding the examination which had been ined by the committee of management at the mination of the examination held last Midsummer. interest which the Prince of Wales felt in the ol, as the suggested nucleus of the proposed Royal ege of Music, led his Royal Highness to appoint ody of examiners himself, and to give them ructions for the formal discharge of their duties. full report, dated April 23, 1881, signed by Henry ie, Chairman; Julius Benedict, Knt.; Michael a, Knt.; W. G. Cusins; George J. Elvey, Knt., . Doc.; Otto Goldschmidt; and John Hullah, D., was presented to his Royal Highness.

sition and Prospects of the School.—The committee of agement having been informed that the executive mittee, acting with his Royal Highness the Prince of Wales on behalf of musical education in England, would not be in a position to take over the school, as part of the proposed Royal College of Music, at Easter, 1881, the period when the present scholarships expire, it was resolved at a meeting, held on the 13th November, 1880, that it was desirable to continue the school for one year pending the granting of the charter, and that application should be made to the founders of scholar- ships and other subscribers to renew their subscriptions for that period. In pursuance of this resolution, an appeal was issued by H.R.H. the Duke of Edinburgh, dated 29th February, 1881.

The appeal resulted in the renewal of sixty-three scholarships, the foundation of eight new ones, and the contribution of £510 10s. in new subscriptions. These resources, together with the balance in hand, amply suffice to keep the school going for another year; and the professors without exception having expressed their willingness to continue their respective services, the prospects of the school for the coming year are very satisfactory.

Donations and Loans.—Three framed engravings on musical subjects have been generously presented to the school by H.R.H. the Duke of Edinburgh. The corporation of the Albert Hall continue most munifi- cently to permit the school to use one of their theatres for choral and orchestral practice and for examinations. The great firms of pianoforte manufacturers, Messrs. John Broadwood and Sons, Messrs. Chappell, Messrs. Collard, and Messrs. Kirkman, also still most liberally afford us the gratuitous use of their excellent piano- fortes.

THE MICROPHONE IN OBSERVATORIES.

M. Van Rysselberghe's idea of using the microphone in observatories has been adopted in the Observatory at Geneva, and by the aid of the instrument, in combina- tion with the telephone, the sound of the beats of the normal pendulum have been made audible in every part of the building. M. W. Meyer, assistant-astronomer at the Geneva Observatory, has given the following details in the *Archives des Sciences Physiques et Naturelles.* The microphone is fixed to the exterior of the framework in which the pendulum swings. One of the conducting wires connects one pole of an ordinary sized Meidenger cell with the microphone, whilst a second wire goes from the other pole of the battery through a telephone and commutator with three binding screws, to the microphone. The two wires coming from the coil of the telephone are very fine, and are interlaced so as to form one supple cable. By this means the telephone can be carried into any part of the Observatory, wherever re- quired. Thus, it can be carried up to the top of the build- ing and the course of the stars watched, whilst the ob- server listens to the number of beats of the pendulum. By means of a second telephone, with one wire fixed to the third binding screw of the commutator, the pendulum beats can be heard equally well in the lower rooms of the Observatory, as in the upper portion. The Observa- tory is also connected with the Hôtel Municipal, so that the beats of the electric clock regulator in that building can be heard in the Observatory and compared with the beats of the pendulum in the Observatory. At a certain hour the person whose duty it is to regulate the regu- lator in the Hôtel Municipal gives notice to the Obser- vatory, by ringing a bell, that he is at his post. He then connects his telephone line, and the astronomer tells him how far the regulator is wrong; he puts it right, and re-establishes the microphonic communica- tion, in order that the astronomer may test the regulator again by the pendulum. All this is done in about five or seven minutes. The apparatus is stated to have always worked well.

GENERAL NOTES.

Australian Fruit for England.—A writer, in a recent number of the *Colonies and India*, draws attention to the likelihood of our obtaining supplies of fruit from Australia. He remarks that "soft fruits" cannot satisfactorily stand the length of the passage and the heat of the tropics; but apples, pears, oranges, and walnuts, and even grapes, may fairly be expected to do so. A recent consignment of apples failed to realise a sufficient price to pay the freight; but the freight was unduly high, and the fruit arrived at a time when the market was glutted with Canadian produce. Several cases of grapes have been landed in excellent condition; and there would appear to be no reason, if care is given to the gathering and proper packing of the fruit, why grapes of the best quality should not be placed in Covent-garden towards the close of the winter, and compete favourably with our hothouse produce, whilst the best Tasmanian pears would not fail to lower the price of a guinea the half-dozen commonly asked for Jersey fruit in spring. Both grapes and pears would pay better than oranges, but the latter fruit will unquestionably stand the passage best. The packing of the fruit is the main point; but it must be carefully gathered when free from dew, and packed when not heated by the sun. The air should not be entirely excluded from the fruit, and the use of dry sea-weed is recommended for lining the cases; while if each pear, apple, or orange is separately wrapped in tissue paper its condition will be materially improved. These fruits should be packed ripe; but grapes may be left to mature on the passage. Tasmanian jams are now to be bought in London shops; and, with the fast steamers now running, many of them provided with ice chambers, there is no reason why a little care and experience should not result in Australian fruit being placed in the English market in sufficiently good condition to ensure a remunerative return to the exporter.

Indian Exhibition.—An Exhibition of the products of India is to be held in December of the present year, and continued during January, 1882.

Congress of Electricians at Paris.—The Chambre Syndicate d'Electricité has organised an international meeting of electricians to take place in Paris between the 1st and 15th of October. *La Révue Industrielle* says:—"The congress will treat of theoretical questions; the meeting will lend itself by preference to the purely industrial and commercial side of the question. It will study the ways and means necessary to enable electricity to take the place it merits in our advanced civilisation." The president of the Chambre Syndicate d'Electricité is M. H. Fontaine, and the president of the organisation committee is M. Armengaud, jun., to whom all papers, &c., intended to be communicated at the meeting should be sent before the 15th September, at No. 10. Rue de Lancry. M. Boistel has been appointed treasurer of the meeting, and to him the subscriptions, amounting to thirty francs for each member, should be addressed. These subscriptions are intended to defray the cost of publishing the papers that may be read.

Panama Canal.—The engineer in charge of the boring operations being carried out for the Panama Canal reports, according to the *Engineer*, that the borings had proceeded to a depth of about 100 ft. from points, the altitude of which varied from 200 ft. to 260 ft. above the level of the sea, without encountering the rock *in situ*. The material was apparently a more or less dense brecchia or conglomerate of rounded fragments of rock embedded in argillaceous matter. The fragments of rock are in a state of decomposition, and, after exposure to the atmosphere, a slight touch will cause them to separate into concentric layers, leaving a compact central nodule. The existence of these globular blocks on all sides, and distributed over the surface through the defile, leads to the inference that the geological structure of the *col* to be cut through will prove to be similar throughout, more especially as the rocks met with most abundantly on the Isthmus are conglomerates and tufa.

Railways in 1880.—Although the "Railway Returns" for 1880 have not yet been issued by the Board of Trade, some of the main features of the movement, as ascertained from the "Statistical Abstract for the U dom from 1866 to 1880," has been given in the the following figures the returns for 1879 can l with those for 1880:—

Length of railways open in the United Kingd

1879	17,696 mil
1880	17,945 ,

Total capital paid up in shares and loans:—

1879	£717,003,4
1880	728,621,6

Number of passengers conveyed (exclusive ticket holders):—

1879	562,732,8
1880	603,884,7

Number of passengers per mile:—

1879	31,8
1880	33,6

Total traffic receipts:—

1879	£59,395,2
1880	61,958,7

Traffic receipts per mile:—

1879	£3,3
1880	3,4

Working expenses:—

1879	£32,045,2
1880	33,502,3

Net traffic receipts:—

1879	£29,731,4
1880	30,985,0

Lead in Germany.—The returns for the lea tion in Germany, during 1880, show that 853,05 produced, against 825,567 cwt. in 1879, or 27,48 than in the former year.

Australian Colonies.—A statistical retu relative positions and aggregate importance of the Colonies at the close of the year 1879, has been late at Sydney, from which it appears that the total ar miles is 2,580,282½, and the estimated mean 2,659,779; the revenue was £15,927,488, made up —New South Wales, £4,475,059; Victoria, £ South Australia, £1,662,498; Queensland, £ Tasmania, £375,367; Western Australia, £196 Zealand, £3,184,905; total number of miles of ra 4,338½; of telegraph lines, 26,841¾; of telegr 43,816¾. The number of horses, 1,064,640; of cattle, of sheep, 65,914,236; of pigs, 822,039. In these New South Wales is greatly in excess of the othe thus of sheep the number in New South Wales is while in the other colonies the numbers stand as Victoria, 8,651,775; South Australia, 6,140,396 land, 6,065,034; Tasmania, 1,834,441; Western 1,109,860; New Zealand, 13,069,338. In respect Queensland nearly equals New South Wales, being—New South Wales, 2,914,210; Victoria, South Australia, 266,217; Queensland, 2,800,6 mania, 129,091; Western Australia, 60,617; New 578,430.

Gold Production.—It is reported that the total of gold in the whole world last year was 118,000, nearly half of which was mined on the continent of The product of silver is said to be 94,000,000 dols., 76,000,000 dols. was produced in that country. T total of precious metals was, therefore, 212,000,000 increase, as compared with the three preceding yea

International Exhibitions.—An Industrial tion will be opened at Oglethorpe-park, Atlanta, G the 5th October, which will remain open until December. It was originally named the Internatio Exposition, but it was subsequently decided to textiles, and now all industries are to be inclu South American and International Exhibition to Buenos Ayres, will be opened on February 15, 18 English merchants, at Shanghai, propose to International Exhibition to be held in that city in

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ions for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

EDINGS OF THE SOCIETY.

CANTOR LECTURES.

E ART OF LACE-MAKING.

By Alan S. Cole.*

.—DELIVERED MONDAY, APRIL 11, 1881.

upon a material. Needlework upon separate Venetian needle-point lace. Needle-point lace. French needle-point lace-making English and Flemish needle-point lace.

previous lecture I tried to show when the naking arose, and by whom it was first This evening I propose to deal with one ipal methods of lace-making, and the ked in this method. Lace, as an ornaopen arrangement of threads, has been roduced in various sorts of threads. We f gold and silver threads, of white, black, d silks, and of white threads, which e of linen or cotton. The white linen is that in the production of which the le artistic designs have been used. , with this particular class of lace, I proto deal. Broadly speaking, hand-made l lace is a textile fabric perfectly distinct r from a woven textile fabric. As a en material is close, and patterns are it by varying the interweavings of the l by using variously-coloured threads. hand-made lace is produced by looping, or twisting threads together. The loopwith a sewing needle, and the thread, the needle, is constantly at work, being . looped around and between certain ls, which form the backbone of the e wrought. Plaiting and twisting is ing several free and loose threads one er, so that single threads are by turn o operation. This latter method comes eading pillow and bobbin-made lace, his we shall deal in the next lecture. ent, we are to consider the looped and ad work done with a needle, and hence e-point lace. Needle-point and pillowtwo chief divisions of the hand-made out some acquaintanceship with the their productions, it would be difficult rtain of their salient characteristics. it, the difference between these two classes of lace (pillow and needle-point) is often quite marked. For instance, one may compare a piece of Valenciennes pillow-lace with a piece of Venetian needle-point lace. The Valenciennes pillow lace is quite flat and thin in appearance, whilst the Venetian needle-point lace is marked by portions in relief and a sort of modelled appearance. (Figs. 1 and 2.) A similar difference would not be apparent if we compared the same piece of Valenciennes with a very delicate Venetian needle-point lace, called "point de Venise a réseau."

FIG. 1.

Valenciennes pillow lace.

FIG. 2.

Venetian needle-point lace.

The variety of pattern which we should find in three such specimens could not even be taken as a guide to class of work, as respects needle-point and pillow-lace, since, in the halcyon days of lacemaking, the same pattern might be worked by the needle and on the pillow.

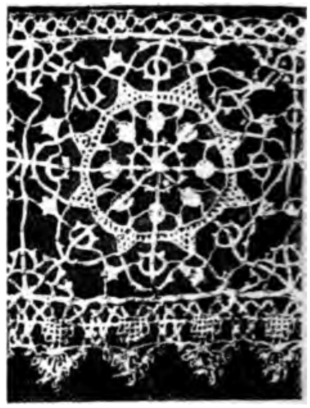
III. Attention to the characteristics of workmanship in laces has often been too slightly paid by those who have otherwise shown themselves to be connoisseurs in the matter. The late Mrs. Bury Palliser, whose name is closely associated with

the history of lace, not unfrequently had failed to acquaint herself with such characteristics. She described some needle-point lace as pillow-made lace and *vice versâ*. It would be ungrateful on my part if I allowed you to infer from these remarks that I was not sensible of my indebtedness to Mrs. Palliser's "History of Lace." Her patient research was almost exclusively devoted to the exhumation and laborious accumulation of records about lace. In this respect chiefly her history of lace is a valuable volume of reference. I must repeat, however, that records and writings hardly seem to be a first source from which materials for forming an acquaintanceship with lace-making are to be drawn. The abundance of existing specimens of all sorts of lace invites our attention, and enables us to trace developments and phases of the art in its productions. When methods of workmanship and styles of design have impressed themselves upon us, then we may have recourse to records and writings, and fit together in as complete a way as we can, the evidences we have thus obtained. I will not say more on this matter, but proceed now to ask you to consider with me features of workmanship in needle-point laces.

IV. Without referring to any particular class of needle-point lace, it will be seen that a beginning must be made somewhere. The pattern governs this beginning. Say then we want to make a little square in lace. We first draw the form on a piece of paper or parchment. Parchment being less destructive is the best. Then lay upon the lines a thread which is fastened here and there to the parchment by stitches. Having completed this thread skeleton pattern, we begin to build a compact covering of white threads upon it, which we do in ordinary button-hole stitch, the result of which is that the skeleton outline becomes a well-marked figure. This is the very simplest form of needle-point lace. If we want to go a little further, and place, say, a pattern in the centre of the square, we should draw one pattern, and then outline it with thread, taking care to attach the lines of this addition to the main lines of the square, and then we proceed with one over-casting of button-hole stitches. There remains now the question how the pattern is to be taken off the parchment. This is easily done, by neatly cutting the stitches at the back of the parchment, which stitches you will remember were those which held the first skeleton outline down. The lace is thus released from the parchment, and the pattern is ready for use for another piece of lace. However, all that we have done is to produce a sort of geometric form of even lines, and this is virtually all that was done at the commencement of needle-point lace-making. Much depends, as you readily perceive, upon nice thread and careful patient working; the least scamping or putting a loop out of its order, takes away from the compactness of the work; and irregularity and loosely made lace condemns itself.

V. Before leaving the early and geometric stage of lace, as we have seen it, which, by the way, was called "punto in aria" (see Fig. 3), a term you will recollect from my first lecture, I think we may find it useful to glance at a few of the classes of white thread embroidery which existed before, and contemporary with "punto in aria." We have seen that the beginning of lace is separate threads. This is quite reverse broidery, which requires a stuff as a found

FIG. 3.



"Punto in aria."—Geometric design, with an edging of and twisted threads.

VI. When the fashion of ornamenting white garments was getting up to its zenith, devised methods of decoration other than merely loading the surface of a stuff with broidery. A lightness was obtained by cuttin bits of the stuff, or by punching series of little like the tailor bird. One of the more elabo forms of this cutting-out work was 16th ce Venetian "reticella," which is also called times "tagliato," or cut work. The desig this sort of work, difficult to distinguish from "punto in aria" done from similar patterns, a geometric. The principal lines are rectiline this arises from the fact that the cuttings-out the stuff generally followed the woof or w the linen. These rectilineal lines consist of very narrow strips of linen, or three or four uncut threads, worked over with button stitches, just as our skeleton outline in "pu aria" was secured. Between these lines circular and radiating forms, which were like "punto in aria;" and it is curious to that, although the embroiderers of lin devised methods of inserting into places of linen such open ornamented work as done i

FIG. 4.

yet they seem to have been some little time they were able to work this sort of ornamen to form a band or trimming, independently as a foundation.

VII. Another cut or "tagliato" wor with linen was of a very obviously c racter, as you see from the specimen here This vandyked scroll is cut out of a strip o and is picked out with fine gold wire, f along its edges. (Fig. 5.) The name "ta

or cut work with leaves, was given to a kind of lace, and this has led to some ; as the term "cut" indicates a process

FIG. 5.

Vandyke of cut linen work.

thing to do with the making of lace like . 2, which was, nevertheless, called "tagiami." Much as it may look like cut linen, reliefs and ornaments embroidered upon ine specimen of very elaborate lace-work, entirely by needle and thread upon a t pattern, so that cutting has nothing to the shaping or ornamentation of the

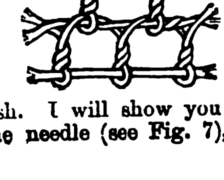
Continuing with the white embroideries ff, we may look at a specimen of drawn ork. Here we have another sort of work, from either of the cut works. The withf the threads regulated the pattern to ed. A well-curved scroll had to be conbeing approximately rendered in small The back ground to such work appeared t of a net of square meshes. This effect ned by whipping fine thread around the threads of the stuff. Just the reverse work is the very well-known darning t, of which there are many made imitations now. For this sort of rederic Vinciolo made many patterns, the earliest of which date from about he Italian name for the work was "punto ," and the French "lassis" or "lacis." lians, or rather Venetians, preceded nch in this sort of work, though ch carried it to a degree of admirable n. I remember that in the South Ken- Exhibition of 1874, there was a most specimen of this darned work, a large tain, or altar cloth, set with squares of upon a net ground, in which were repregures of the zodiac and of the seasons. hem were after designs by Vinciolo, as seen in such well preserved copies of his those belonging to Mr. Alfred Huth, dly allowed me to consult his copies of It was particularly interesting in this anging to notice the final squares, in one were the words, most carefully darned, *Louant Dieu j'ai fini mon ouvrage*, "praising God I have finished my work," and in the other the name of the worker, "Suzanne Lescallez, 1595." The cloth, after the Exhibition, went back to France, and I don't know where it is, but it is so complete a specimen, that if by chance any one happens to meet with it, I hope they will make a careful note of its whereabouts. On a far smaller scale, and of altogether less artistic importance, are the few squares of "lacis" or darning, introduced into this cloth. (See Fig. 6.) Those appear to be reproductions of some

FIG. 6.

Corner of an embroidered linen with squares of "lacis" and "Reticella" inserted, and edged with twisted and plaited threads.

of the smaller designs by Vinciolo. This Vinciolo is an important personage in the history of lace. Besides the darning work, or "lacis," which is not lace, he popularised the taste in France for "points coupés," the French name for "reticella" and cutwork, and also for "punto in aria." He seems to have borrowed much from different sources, and it is interesting to compare his patterns with those done by C. Vecellio, a notable and rather later designer and writer about costume towards the end of the 16th century, and some relation to the great Titian, and with those done by a much-esteemed woman, named Isabetta Catanea Parasole, whose patterns were published in Rome about 1590 and early in the 17th century. No doubt Vinciolo owed much of his success to the patronage which Henry III. and Henry IV. of France and the ladies of the French Court accorded him, though, at the same time, we must not forget that he was a man of energy and refinement, as his books show. He is almost the only early pattern maker who attempts a description of how the patterns are to be worked. His descriptions, however, are more enthusiastic than instructive. They are given by him in verse, in what he calls a discourse upon "Lacis." His divine *chef d'œuvre* is not a matter of chance; it has been well considered and planned by number and measure. Before leaving the "lacis" or darning on net, I would observe that the name given to the net was "résuil," and this name must be noted, since we find it, later on, applied to ground-works of meshes used in laces. You, all of you, know what netting is, and how simple an operation it is to

FIG. 7.

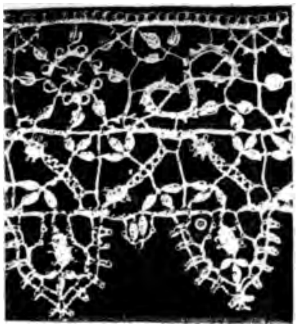


make one mesh. I will show you a few meshes done with the needle (see Fig. 7), and you will

then see the far greater complication of this work, as compared with netting, and yet the name "réseau" in France applies to both.

IX. We have now examined different sorts of embroidery on linen. (1) Work done by cutting holes into a linen foundation; (2) work done by cutting linen into shapes; (3) work done by drawing out threads, and so leaving a linen pattern; and (4) work done by darning a pattern into network. We have also seen specimens of the early geometric laces—the "punto in aria," or button-hole stitch work done upon a thread skeleton; and now I should like to show you a piece of mixed work, in which a little more than mere geometric form is displayed. (See Fig. 8.) The

Fig. 8.



Vandyked border of mixed work, the upper part of needle-point, the lower and dentated part of plaited and twisted threads.

upper part is all of needle-point work, whilst the lower is of plaited work. Some of this plaiting may, no doubt, have been done with a hooked needle. However this may be, I thought is useful to show this specimen, in order that you might not fancy that the whole of a single piece of early work was done in one method only. Patterns for lace like this are to be found, especially in Vecellio's books, about 1590 or 1600.

X. We will now look at a few specimens, from which I think we shall trace a freer sort of design, and, consequently, an increased display of ingenuity in workmanship. We have hitherto seen ornaments, more or less dependent in their construction upon squares and their diagonals. But the pattern-

Fig. 9.

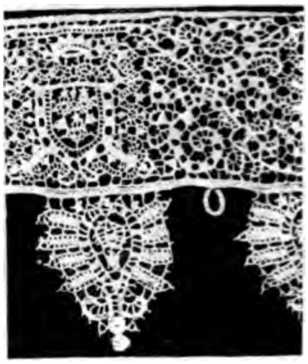
Italian needle-point vandyke.

books of the end of the 16th century give us designs for scrolls, with the introduction of all kinds of odd figures to be worked in lace. The

specimen of this class (see Fig. 9.) dates, pr
from about 1580. I want you to notice h
different details in the design touch one ano
different points of contact. There are v
little tyes. Considerable parts are of flat-l
work, work which in this photograph lool
linen. It is composed of a series of closely-
loops worked very much as shown in Fig. 4.

XI. In the specimen in Fig. 10, I

Fig. 10.



[Needle-point lace, showing use of tyes or "brides."

you to notice the numerous little tyes whic
used to hold the pattern together. These ty
called "brides." The design too of this p
more vivacious than the simple rosettes and r
tions. In the centre we have a shield surmo
by a crown. Curves slope from each side of
meet beneath a sort of fan pattern, from the
which grow a little *fleur de lys*. The van
which hang beneath, are repetitions of thi
device, and are terminated with little balls.
tween the vandykes are small loops, which su
loops for buttons, but I cannot say for what
ticular use this specimen was intended. Fro
character of the design I think the specimen
from about 1580 to 1590, and is Italian. It m
of course, be a French or other imitation of It
work.

XII. Very important work of this
character was made, and amongst the
threads gold threads were introduced. I b
that Sir William Drake possesses a
specimens as ever were wrought of this
and gold thread needle-point lace. They a
think, of early 17th century design and w
manship. Originally they came from Mes
to which place they may have been taken by
wealthy person at the time when that city w
centre of considerable importance, notable fo
independent and aristocratic prosperity.

XIII. In the succeeding examples, you
notice a development of flowering stems
scrolls. A change of design had thus begu
take place at the end of the 16th and begi
of the 17th centuries. Here (in Fig. 11) you
see too a greater use of the "brides" than
we have previously noticed. Along the bord
the stems or scrolls is a little raised line. Th
called the "cordonnet," a feature not obser
in the fine gold and white flounce of Sir W
Drake's. Parts of the pattern are diversifi

f stitch. Instead of compact work every- should see little open works. In the centre : the little blossoms there are wheels and

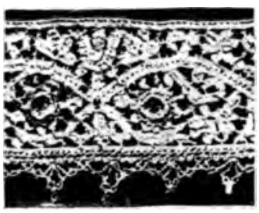
FIG. 11.

Venetian needle-point lace.

lines. These details are worthy of our , and are called fillings-in, or "modes." specimens of the first forms of elabora ice, which in their further matured state mportant features, giving delicate grace ance to laces of the best period.

:t may have been about this time, namely, iencement of the 17th century, that lace pressed tape into their service. Instead ly composing their scrolls and flowers in oled stitched fabrics, they found tape · comparatively rough and ready general swer their purpose. Here we have two

FIG. 12.



ith needle-point work and an edging of plaited and twisted threads.

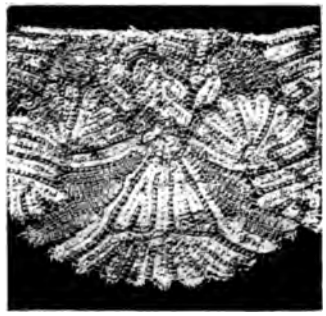
of tape lace combined with needlework. in pillow lace also used tape in a similar iis little strip (see Fig. 12) may be Italian,

FIG. 13.

Tape lace worked with the needle.

lace was not only produced in Italy. This (see Fig. 13) may not unlikely be of workmanship. My reason for thinking it is the style of the flowers along the borders, which appears in a lace (see Fig. 14) much liked by the Flemish in the first half of the 17th century. The points of resemblance lie in the

FIG. 14.



Flemish lace of the 17th century.

arrangement of the petals of the blossoms, which takes a fan shape.

XV. Before leaving the question of tape laces, it may be well to state that the weaving of tape seems to have been begun in Flanders, about the end of the 16th century, or the beginning of the 17th. Tape, so far as I have been able to ascertain, did not come to be made in England until the 18th century, when, according to a note I have had from Messrs. Phillips, the well-known tape manufacturers at Manchester, their predecessors brought over, in the year 1747, two Dutchmen, of the name of Lanfort. Under the tuition of these Dutchmen, the people in the village where Messrs. Phillips have mills at the present time, learned how to weave tape in the loom. The start in England was up-hill work, because of Dutch competition. There were at least 1,000 looms at work in Holland before there was one in England. However, in about thirty years, the trade greatly developed, and, in the course of a half century later, several other tape looms were started. This was about 1820. Since then the manufacture has increased. Before 1822, tape was made in cottages; but, in or about 1822, the idea of getting the workers and their looms under one roof had taken root, and mills were built. Then came steam power and water power for driving the looms, instead of human power. Effective work has been done with tape, in connection with the method of pillow-lace making. Work of this sort is sometimes called guipure. But guipure is a class of work totally distinct from this, and about guipure we shall hear something in the next lecture.

XVI. However, we must now return to needle-point laces. Up to the present we have arrived at scroll designs more or less flatly worked, held together by tyes or "brides," enriched with little varieties of "fillings in" or "modes," and emphasised with small raised lines or "cordonnets." All this sort of work was done upon a thread skeleton pattern just as the first needle-point laces were made. Fancy in design and workmanship, however, was now becoming quite vigorous. We enter a period, soon after the commencement of the 17th century, when lace workers produced beautiful solid looking work,

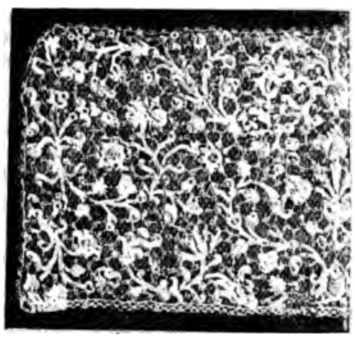
which is almost like fine 14th century Gothic tracery, carved in ivory. Its exquisitely worked relief carried recent admirers of it far away from the time when it was first produced. They tried to identify it with a needlework which an Italian poet, Firenzuola, a hundred of years before the existence of this relief-lace, described as "sculptured in relief." As the size of the altar-cloth, flounce, border, or collar seemed to demand, so did the lace-workers vary the size of their designs and work. For instance, a collar would be designed and worked as this one. (See Fig. 15.) The

FIG. 15.

Part of a collar of minute Venetian needle-point lace.

figure is not quite distinct, in showing the amazing delicacy of the relief work and its enrichment. Each of these little blossoms, actually about the size of sixpence or threepence, is a bouquet in itself of hundreds of the most finished lilliputian loops, finely worked in button-hole stitches. Again, for a border or an ornament to hang beneath the chin, we have specimens such as this (see Fig. 16),

FIG. 16.

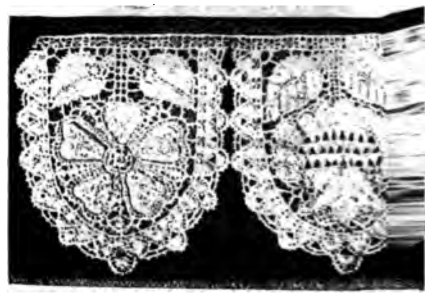


Venetian needle-point lace.

and in this specimen the decorations worked upon the little tyes should be noted; while, for a sort of collar, the ends of which spread flatly over the breast of some courtier or minister, say like Colbert, we have samples as shown in Fig. 2. In all these specimens is a rich expression of stately scroll design—varied fillings-in or "modes," "galleries," or successions of minute loops "picots" placed one above the other. This was the kind of splendid needle-point lace, exclusively originating, I think, from Venice in the 17th century, which the nobility and wealthy personages of the time wore, and of which vestments and altar-cloths were made for churches.

XVII. A contrast to this galaxy of ... lace is to be found in the needle-p... England during the 17th century. A ... lies on the table, in which is shown va... on vandykes of English needle-point ... 17th century. Remarkable amongst ... two larger vandykes, which you will ... the one, a figure of a man—the other, a ... a woman, depicted in the costume of the ... The way in which this work was done i... similar to 17th century flat Venetian n... lace. Here is a specimen of the English ... Fig. 17.)

FIG. 17.



English needle-point lace.

XVIII. Scallops of "punto in aria," insertions "reticella," and of similar design, may also be ... in Westminster Abbey carved upon the tombs of ...

FIG. 18.

English sampler with needle-point stitches.

infant daughters of James I., which are ... 1606 and 1607. Who may have made them, ... can say? In the English sampler of lace sti... (see Fig. 18), we have, luckily, the maker's ...

greet May, 1654" wrought this it you will see cut-work, drawn cella" work, and "punt in aria," it stitches. It is a most valuable English lace work in the Purin school children like "Margreet d to have an interest and to take own labour. Such as she were, be extinguished by a mere er, or lost in the midst of numeri-indard.

now ask you to put yourselves so back before this 1654, and to ion up to which we seem to have nt lace making and design.

le tyes holding the patterns hitherto been but arbitrarily re seen that at first they were plain Figs. 10 and 11; we have noted the m by means of the addition to ops or "picots," as in Fig. 16. o a period when the designers to an orderly pattern, similar to the bee. Messrs. Hayward have ry remarkable flounce, in which honeycomb ground is seen, and from smaller specimen, which was

Fig. 19.

enetian needle-point lace.

to a chalice. The little tyes ornaall loops form a background of style of design is no longer dignified scroll, but consist of a gement of fragmentary details, in on of which clusters of picots is imilar style in using disconnected bservable in Messrs. Hayward's

efore quitting the long flowery you to observe the varieties of growth of which we had begun to 1, and I again refer you to the scroll work. (See Fig. 2.) At that new effects were being tried d workers, the best forms which hese attempts were also preserved you will see that, although in design supplanted one another, there were lingerings of old styles contemporaneously worked with new styles. And it is the consideration of incidents like this which I think must always puzzle connoisseurs of styles of ornaments in their attempt to fix a very precise date to a certain pattern. We may know that such and such a pattern may have been worked at a certain date, but we cannot fix with precision its first introduction, or its final appearance, neither can we be confident that a repetition of it may not be of very later date.

XXII. With the style of balanced arrangements of detached ornaments which is closely connected with the style known as Louis XIV., we find the first indications in lace of a groundwork of meshes made with a needle. (See Fig. 20). This

Fig. 20.

Needle-point lace with ground of fine meshes.

figure is rather indistinct, and does not show the ground of meshes clearly. Perhaps, however, the indications of it are sufficient to let me ask you to take my word for it that the ground is composed of meshes, which are in the main similar to those of Fig. 7.

XXIII. You will hence note how that we are getting into a period when grounds of meshes were being used. The daintiest of all Venetian needle-point laces, with fine grounds, is the "Point de Venise a réseau." This most delicate work was contemporary with soft pillow-made laces, which no doubt were intended to be its rival. In its production were combined the highest elaboration of design and workmanship, together with a thinness and beautiful softness of texture. It is one of the rarest of all laces. It marks a transition from preceding heavy to succeeding light laces. It followed the change which articles of costume, like collars and cuffs and trimmings, underwent from the 16th to 17th centuries.

XXIV. High-standing ruffs, like those worn by Queen Elizabeth, had been trimmed with "reticella" and geometric "punto in aria." But the vandykes expanded in size, and instead of shooting off from borders of the ruffs, became unmanageable for such

and a climax of this softness is to be found in the remarkable "Point de Venice a réseau." The old vandykes had, in fact, disappeared, though their name, "dentelles," was retained for their successors, from which the dentated character was almost entirely extinguished.

XXV. We have now arrived at about 1660 to 1680, and this is an important date to remember in connection with the history of lace.

XXVI. A view of the situation might be stated to be, Venetians, at the end of their famous hundred and twenty years of work, to bring lace to a perfection, and other countries doing their utmost to acquire the art from them; some, like the Flemish, progressing slowly and naturally, following Venetian patterns upon the pillow; others, like the French, bent upon stepping by any means to a front rank.

XXVII. The desire of the French to be able to make fine lace was undoubtedly most strongly expressed in an edict dated 1660. Louis XIV.'s minister —Colbert—was the prime mover. He had taken stock of the increasing love of the French people for Venetian and Flemish laces. His love for the fine arts in all their branches, and his great energy, were principal elements in the framing and issue of this celebrated edict. Through it lace-making establishments were founded at Alençon, Quesnoy, Arras, Remis, Sedan, Chateau Mierry, Loudun, and elsewhere. The State made a contribution of 36,000 francs in aid of the formation of a company to carry out the work. Instructions were included in the edict that the lacemakers should produce all sorts of thread-work—as much those done with the needle as those worked on a pillow or cushion, in the style of the points which were made at Venice, Genoa, and Ragusa, and other foreign countries. These French imitations were to be called "Points de France;" and although attempts have been made to identify certain laces as "points de France," I think, considering the variety of laces which were to be imitated, and the classification of them under the

the minister Colbert on his w
'lavori d'aria' to perfection;" an
Domenigo Contarini, jealous of th
were evidently ensuing, to the p
making in Venice, alludes to the
"which the French can now do
Thus, from 1660 to 1677, we hav
French labour, under State prote
systematically trained, by import
structors, in the art of lace-makin

XXIX. The style of design adopt
was certainly much more floral than
was lighter, and more in accord w
of texture which lace was devel
Great attention was paid by
ground-works, which, in respect
comb "brides" (see Fig. 19), and
(see Fig. 20), they distinctly o
Venetian masters. Mrs. Bury P
that French lace-makers could
imitate the true Venetian stitches,
for points d'Alençon were planne
meet this deficiency, but I think t
specimens here before us will be s
us that, however fresh a departur
taken by the French in the matte
cunning in doing delicate need
became as great as that of thei
Venetians. It is surprising, I thi
people become if they have not fi
the difference between design an
The best ability in representing
generally runs a risk of being co
the pattern, and not the workman
be condemned; and very often pr
of such cases occurs, when a well
in spite of bad or inferior work
itself, and is then held up as a go

XXX. To return, however, to
works, and their particular
early distinctive French needle-
will remember the regular he
of Venetian laces (see Fig. 19).

ntan and that of Point d'Alençon appears. 1.) The clearly defined honeycomb ground centre of the figure is Argentan (so called), ie cloudy ground, composed of fine meshes, Jençon ground. Judging from the pattern of ›pet, I think it is likely to be of the latter end 17th century.

FIG. 21.

French needle-point lace.

XI. The variety of groundworks and fillings- ie Alençon laces is very remarkable. Large s, like one which belongs to Mrs. Alfred on, are rich in all sorts of fantastic devices, gn, and of work. The underlying principle stitchery is the button-hole stitch, worked keleton patterns of fine thread, and sometimes ehair. Here is another specimen of Alençon The groundwork is composed of what is l "réseau rosacé." This "réseau rosacé" con- f little solid flat hexagons of button-hole d work set in frames of hexagons. A special teristic of the Point d' Alençon laces is the -hole stitched "cordonnet." In the Venetian t à réseau" the outlines are of a thread. You tice this if you examine the actual specimens iown. To thoroughly enter into minutiæ ese of fine lacework would, I am afraid, take o considerations almost never-ending. I [have been able to present to you this g a sort of connected chain of phases of -point lace-making. I might extend it :, and speak of the Brussels needle-point It is, however, more or less evident that emish or Belgian, in the matter of needle- lace, imitated their neighbours the French, ı no doubt they had imbibed a large amount owledge in the course of their far earlier ns with the Venetians.

XII. I would conclude my remarks this g by saying that the basis of all needle-point the button-hole stitch, and that the features rk which you have to detect in judging a -point lace from a pillow-made lace are of this button-hole stitch.

MISCELLANEOUS.

ORANGE CULTURE IN SYRIA.

notes on orange culture in a recent consular from Beyrout, are quoted in the *Times*, from we learn that the two districts in which oranges are the most plentiful are those of Jaffa and Sidon. The orange trade began to assume consider-able proportions some 40 years ago, when the new government of Egypt took shape, and it is now one of the most profitable in the two towns above mentioned. Unfortunately the inhabitants, allured by first gains, commenced planting gardens, and expending money beyond their resources, the result of which has been that, in spite of all remunerations for small outlays, their improvidence has placed most of them in the power of money-lenders, who continue to advance at interest of 15 to 20 per cent. However, a company has lately been formed in Jaffa to negociate loans with orange cultivators, and if its operations be carried on fairly, we may expect an extension of horticulture, with benefit alike to the company and the borrowers. At the present moment Jaffa possesses some 340 gardens, averaging from 2,000 to 2,500 trees in each. The crop of fruit from these may be put down at about 36,000,000. A garden costs from 40,000f. to 50,000f., and brings in 4,000f. to 5,000f. per annum. For several miles round Jaffa extends a fertile plain, on which water is always to be found at a depth of 40 ft. or 50 ft. With capital and enterprise much of this might be planted, and the orange trade doubled in a short time. The present system of irrigation is that of small wells, from which the water is drawn by mules; but experiments have proved that very little engineering skill would be required in order to turn the streams of the River Andjah, some four miles from the town, over the plain. The land near Jaffa would then be cheapened in proportion as the value of that freshly-watered rose. At present, unplanted land close to Jaffa, able to support 2,000 trees, is worth 2,000f. to 3,000f.; but at two or three hours' distance it will fetch only 5f. to 6f. a deunum. The export is carried on chiefly by sailing boats for Egypt and Constantinople, and by steamers for Russia, Trieste, and Marseilles. Exportation in cases is a comparatively recent introduction, which has given considerable impulse to business with Europe. The orange gardens of Sidon are cultivated on the same principle as those of Jaffa. An acre of land at Sidon is generally valued at from 6,000f. to 7,000f., and is capable of bringing in an income of about 600f. The exportation begins in September, and is at first almost exclusively directed to Russia, till the winter closes the Black Sea ports, when it is continued to Trieste and Egypt. European cargoes are packed in paper and close cases, the rest are sent in open crates. Each case contains some 300 oranges or lemons, and last year's export is reckoned at 20,000 cases, all of which fetched very high prices, especially lemons in Russia. The average prices are for 1,000 lemons 150 to 170 piastres; while for 1,250 oranges, reckoned as a trade 1,000, the cultivator receives 70 to 80 piastres.

ESPARTO OR ALFA.

By C. G. Warnford Lock.

The celebrated German traveller, Dr. Gerhard Rohlfs, devotes a whole chapter of his new book, "Neue Beiträge zur Entdeckung und Erforschung Africa's," to the subject of "Esparto, and its Increasing Import-ance in European Commerce," from which the following notes are condensed:—

A portion of the Sahara, known to the French as *le petit désert*, comes within the influence of moisture-laden winds, and is clothed with vegetation. One of the most useful plants, covering almost the whole district, is esparto or alfa (*Macrochloa* or *Stipa tenacissima*). Long known and locally utilised for mat-making, it is only within recent years that the true value of this plant, which needs neither care nor culture, and thrives with a minimum of moisture, has been recognised. It grows in thick bunches close together, presenting a subulate appearance, and reaching a height of six to ten feet. The tenacity of its fibre constitutes its industrial value, for

it is scarcely fitted for consumption as fodder. Indeed, Duveyrier states that it has such a powerful constipative effect, that the shepherds of the desert edge drive their camels and sheep every third or fourth day to drink at mineral springs, in order to counteract the binding action of the esparto diet. Rohlfs himself noticed how soon the camels and sheep grew tired of grazing upon it.

The one word PAPER explains the whole importance of esparto. The day has long since passed when rags and similar stuff sufficed to supply the world's needs of paper. The moment has arrived when new sources of paper material must constantly be sought. This is easily explained when we reflect that the yearly consumption of paper by the four great cultured nations of the world stands thus:—England, 13½ lb. *per capitem* of the population; America, 12 lb.; Germany, 10 lb.; France, 8¾ lb. These figures are always on the increase. And though Russia takes only about 1 lb., and Austria 4½ lb., the amounts in both these countries double themselves with every generation.

No plant seems better adapted for paper-making than esparto. It may be regarded as an inexhaustible source of wealth, not only in Algeria, but for all northern Africa. Algeria already owes a portion of her railways to this plant. The section from Arzew to Saida is approaching completion, and others are in progress. Some seven or eight million acres of esparto ground exist in Algeria alone.

Hitherto, the greater part of the esparto grown both in Spain and North Africa has gone to England, though the Americans are beginning to import direct from Africa. Up to the present, German paper-makers have not availed themselves of the use of this plant. England, in 1868, imported 95,828 tons—92,927 being from Spain, and the rest from Algeria. But Algeria rapidly attained greater importance, while Spain fell off. In 1874, England's imports were 119,188 tons—54,942 from Spain, and 37,516 from Algeria. Since 1870 other countries have contributed to the total. Tunis and Tripoli figure in 1871 with 11,579 tons, increased to 18,670 in 1874. Malta provided 3,261 tons in 1871, and 7,185 in 1874, not of its own production, but derived from Cyrenaica, and the so-called Libyan coast plateau.

The influence of other lands, Tunis, Tripoli, Cyrenaica, and perhaps the Libyan coast plateau, upon the Algerian and Spanish trade, has, especially of late years, caused a reduction in price. As, however, in most of these lands, robbery is still rife, Spain and Algeria will long continue to enjoy a practical monopoly. How strongly the rational conservation of this valuable plant is urged in France may be gathered from the following words of the journal, *L'Exploration* (1878, p. 156):—"As in France laws have been made against the felling and destruction of forests, so must the Colonial Government busy itself with the protection of this great staple of the high plateau, and not only severely punish the before-mentioned crimes (burning by the Arabs, and killing of the plants by careless gathering), but also fortify the esparto region against the constant encroachments of the sand of the Sahara. [Rohlfs characterises the latter as a groundless fear, the sand-dunes being, on the whole, stationary.] It must not be lost sight of that all Europe and America are dependent upon Algeria, and that, should the whole esparto district be carelessly left to greedy robbers, who care little for the public property, finally nothing will remain but a neglected waste, an unfruitful steppe." It is as well to observe that, firstly, Algeria possesses, at the utmost, not more than one-sixth of the esparto region, and, secondly, the same land will, when desired, grow excellent wine.

On the subject of adulteration and faulty packing, Dr. Rohlfs quotes at length from Noble's circular of 14th January, 1875.

The preceding remarks indicate what stress is laid upon the export of this plant to France, Great Britain, and the United States, while Germany remains outside. Yet none will suppose that Germany is b superabundance of paper material. The I trade alone has of recent years a value million marks (£500,000). It is therefore German merchants that they should have attention to this material. With this ob at all advisable to go to Algeria, nor to German merchants would find it difficult to ing in competition with the old English ho not the whole remainder of North Africa o speak of Morocco, where, especially south Ger, a wide stretch of country still remains on which esparto forms the chief veg esparto-grown portions of Tunis, Tripoli, the eastward-lying Libyan coast plateau, Alexandria, are absolutely without any r merce; as the natives tear up the espart branch, so is it carried to the shipping p and sent into the market. Here is a field enterprise. Dr. Rohlfs suggests the po establishing esparto paper factories in localities, and supposes that about half of would be available as fuel.

The remainder of the chapter deals wi trade generally, but the whole tenour of it the Germans to no longer remain passive an ful of the resources of North Africa: and Dr not likely to preach in vain to his countrym if these waving acres of esparto offer such ducements to the astute and cautious Germa not merit even greater attention from Already our paper-makers have cause to trem future, since France has made such strides and if our merchants allow themselves to be o by German rivals on neutral territory, we have to import all our paper from the Con spite of all that Mr. Routledge is doing for u

CORRESPONDENCE.

AUSTRALIAN FRUIT FOR ENGL

I note with interest the information in the 9th inst., page 778, that we may expect fruit kinds from Australia. No doubt apples, oranges can and will be shipped to advantage this country, because all these fruits ripen a plucked; but I think the writer in th *and India* is over sanguine as to first-cla being able to stand the voyage, and to such good condition as to compete with ho hot-house productions. Be that as it may, my of thirty years as a grape grower teaches me t never ripen in the slightest degree after being but merely wither and shrivel, &c. I think growers are agreed on this point. If I am shall be glad to be corrected. JAMES

44, Spring-gardens, Manchester, 10th September, 18

GENERAL NOTES.

Agriculture in Victoria.—From the lately agricultural statistics of the Colony of Victoria 1880-81, it appears that while in 1872 the area was 884,609 acres, under oats 175,944 acres, und 39,064 acres, and under hay 103,206 acres, the 1881, have increased under wheat to 976,416 decreased under oats to 133,910 acres, and incre potatoes to 44,778 acres, and under hay to 24 The average produce per acre is considerably than it was in 1872. In the latter year, the 18·45 bushels of wheat, 18·76 bushels of oats, potatoes, and 1·40 tons of hay. In 1881, the yiel 9·95 bushels of wheat, 17·61 bushels of oats, potatoes, and 1·23 tons of hay.

OF THE SOCIETY OF ARTS.

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EDINGS OF THE SOCIETY.

CANTOR LECTURES.

E ART OF LACE-MAKING.

By Alan S. Cole.*

III.—Delivered May 2nd, 1881.

lace. Fibres and threads twisted and iake rope, cord, twine, and braids. Fringes. 'lets. Twisted thread-work in England in entury. Plaited and twisted thread-work. rletti a Piombini. Simple work done on a lanufacture of pins, guipure, tape lace. s of scroll design. Grounds of meshes and cteristics of pillow laces. Italian, Flemish, French, and English pillow lace.

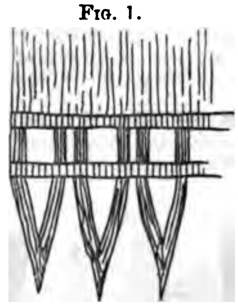
vening we are to consider the second hand-made lace, namely, pillow-made outgrowth of needle-point lace from done upon a foundation of stuff, then or net of some sort, and at length leton pattern of threads, was, I hope, when we last met. The workmanship ent subject is quite different. Pillow-s built upon no substructure. It is a on of a pattern obtained by twisting threads. In the midst of the endless s of forms inspired by the sight of ll sorts, men, animals, flowers, leaves, ell as historic treatments in depicting that which in primeval times claimed eing a pattern, now seems to relegate osition, which, if not considered to be e, is at least so humble as to pass ficance. Nevertheless, students of the rnament find much that is admirable tive in the simplest juxta-posings of irves. And in glancing at the use of ought in twisted and plaited threads ot, of course, omit to note patterns of aracter.

ncestry of laces made on the pillow may examples of primitive twistings and fibres and threads. In my first lecture a few such examples, and I hope you me if I again briefly remind you of y must be dissociated from works of They come into the class of rope, cord, naking. They are also nearly related ords, such as corset laces, sleeve laces, and to another branch of the same ely, narrow braids and tapes. Rope making was known by the Egyptians in early times, and it appears probable, if not certain, that this manufacture was at a similar early date practised by Oriental people living much further west, as in the Hindoo Peninsula, and the immense Mongolian Continent. Amongst the peoples living there, the use of ropes and cords for purely utilitarian purposes was apparently followed by the manufacture of finer plaited and twisted cords and threads made of finer materials than rough fibres, such as coloured silks and metallic threads, wires, or delicate metal strips for decorative purposes. These came "in response to the first spiritual want of barbarous man," which, as Carlyle says, is decoration. At what date fringes were used it is perhaps impossible to say. Besides fringes, there seem to be coeval fine twisted threads upon which to string pearls, precious stones, and beads for personal adornment. As well as these we should not forget girdles or cinctures, which come to us from impenetrable epochs of religious myths. Nets of plaited, golden, and silken threads were worn by Grecian women. Fillets for binding their hair and foreheads were often narrow braids made with silken and metallic threads. Müller specifies the *diadema*, or fillet, which was placed among the hair, and was of equal breadth all round the head. The *tœnia* was usually a broader fillet with two narrower ones at each end. Hercules and athletes are represented as wearing fillets composed of several *tœniœ* twisted together.

* ; of reproducing the illustrations is reserved.

III. We saw an example of the art of plaiting and twisting cords together for borders, 800 years before Christ in Assyria. But the design of this was quite primitive. This primitiveness of design in twisting and plaiting threads appears to have continued for a long time. A different treatment of borders occurs upon the costume of certain Dacians who are depicted in the famous column, coming before the Emperor Trajan. (Fig. 1.) This is some 900 years later than the Assyrians.

Fig. 1.



Border from Dacian costumes, sculptures on Trajan's column (2nd century).

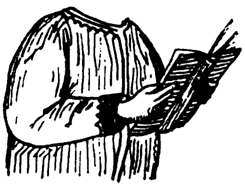
IV. Evidences of similar minor details of costume from the 2nd to the 12th century are scattered, and rather difficult to obtain. Something, however, can be gleaned from early Christian sculptures, frescos, and Mosaics, and from Byzantine works of art.

V. As I mentioned above, the term lace has long been applied to braids and such like. Gold braid especially, or as it is called, gold lace, is of ancient origin. Scandinavians and Danes apparently made such gold lace, remnants of which have been discovered buried in England.

VI. Before stockings came to be knitted, Romans and Barbarians used to encase their legs in strips of coarse, plaited, and woven material. These braids, as they might be called, were neatly plaited round the leg, from the knee to the ankle, as may be seen in the leg coverings on an early sculpture, probably of the 2nd century, if not earlier, of the "Good Shepherd."

VII. But I must not detain you with these instances of antique plaitings and twistings. We have to arrive at the use of finer twistings and plaitings as they may occur in decorating edges of costume. Refined and graceful little ornaments, consisting very much of small golden and silken threads plaited to form flattened cords, appear to have been common in the early 15th century. These little ornaments are frequently indicated along the borders of dresses and robes, such as those painted by Gentile da Fabriano, Fra Angelico (Figs. 2, 3,

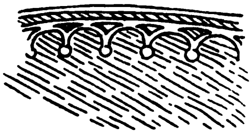
FIG. 2.



A sketch, with indications of ornament along neck and cuffs. From a painting of Fra Angelico da Fiesole (14th and 15th century).

and 4), and Carlo Crivelli. These names particularly occur to me as I have noted examples of the ornamented work we are considering, in pictures by them.

FIG. 3.



Sketch of gold thread ornament, taken from a robe painted by C. Crivelli (15th century).

VIII. About the time of these artists, that is from 1387 to 1493, the wearing of linen garments develops. While women wore linen wound round

FIG. 4.

Sketch of veil, with border of open loops, taken from a painting by Botticelli (15th century).

their heads and necks, the ends falling over their shoulders, men wore scarcely anything which we should now recognise as a collar. A minute indication of an under-linen shirt appeared above the low cut jacket, plaited, or hanging loosely from the neck.

IX. In Holbein's time, which carries us into the middle of the 16th century, the linen come into fashion, as may be seen from portraits. Along these early collars, an the first ruffs, a series of small loops, mac threads, was fastened. This sort of tri called "purling," and is similar to t loops shown upon the edge of a clotl The purse of the carpenter, in the tales, is "purled with latoun." Latour have been a sort of metal-twisted th purling, in its application to collars and was just the reverse of those Italian t ments depicted by Crivelli and others, fastened on to the stuff of the dress, a and 3. The purl was open thread wor to the edge of a border, and was in use century.

X. An interesting inventory of artic ing to the Sforza family in 1493 conta of a pointed border made with "doi bobbins perhaps, or else knitting or hool And this pointed border has been m upon by different writers as being early I think, however, we might correctly s it was a "purling." And if we may c ing" lace, then plaited and twisted belongs to the 15th century. It is, almost as much a lace as the bolder As Roman fringings.

XI. We need not perhaps here etymological depths for the origin of lace. The meaning attaching to it that of many other words undergone Long before plaiting and twisting applied to produce rich and varied de word lace had described the plaited thr in the manners above mentioned. Ar we have a remarkable instance in an MS. of the time of Henry VI. and Edv about 1471. Directions are given in making of lace Bascon, lace indented, dered, lace covert, a brode lace, a roun thynne lace, an open lace, lace for Ha such like. The MS. opens with an il capital letter, in which is the figure of making these articles. But her impleme those with which lace of ornamental qu the middle of the 16th century and on been made. A clear description is given h in combinations of two, threes, fours, fiv and fifteens were twisted and plaited Instead of the well-known pillow, bob pins with which pillow lace is now made, was used. Each finger of a hand had tion assigned to it of serving as a peg. T of the MS. says that it shall be understoo first finger next the thumb shall be called A B, and so on. According to the sort of twi or braid which had to be made, so each of fingers, A, B, C, D, might be called up like a reel, and to hold a "bowys," or a little ball of thread. Each ball migl different colour from the other. A "thy might be made, with three threads, and fingers A, B, C would be required. A "rou stouter than the "thynne" lace might re service of four or more fingers. By occasio ping the use of the thread from certain fing of indented lace or braid might be made. a lace of more importance had to be m

ad lace for "Hattys," the hands of an assist- ere required. In the quaint language of the ., the MS. tells us how we should take a fellow et him on our right or left hand. Thus the r would have an additional ten fingers or n the two hands of his assistant. For still mportant work, two assistants—one standing ch side of the worker—would be required, twenty pegs or reels would come into use. cess like this, involving the employment of so people to produce an insignificant article cury, leads us to reflect upon the immense e which has been effected in four hundred not only in respect of the improved allot- of labour to willing hands, but also as ls the increased demand and consumption of l articles. The very idea of employing s as pegs, sounds ludicrous. The unfortunate or women who passed their time in holding heir ten fingers, cannot have had as much ment out of their work as that which a con- l player at cat's cradle derives from his s. Indeed, according to Adam Smith's n upon the division of labour, they "must lost habits of exertion, and become as stupid gnorant as it is possible for human creatures come." Fortunately, however, in the little in of lace-making, conditions like this were last long.

I. The ingenuity of labour in producing nents in plaited and twisted cords, or laces, f curling them in open loops, and such like, linen collars and cuffs, was not lost upon ners of patterns. For soon after the publica- f designs in "reticella" and "punto in aria," d designs for "merletti a piombini" (Fig. 'Merletti" is the Italian for lace work, and

FIG. 5.

f the neck of a shirt, trimmed with "Merletti a Piombini." Italian. Late 16th century.

iombini" means leaden bobbins. To work like that in Fig. 5, it is apparent that ments other than fingers, or even a series of were necessary. And since traditional practice tes an origin of implements used, we are or less forced into an inquiry as to the nployment of the pillow, of bobbins, and of ll of which must have been somewhat used Venetian patterns of "merletti a piombini" latter part of the 16th century. A cushion d, on which were fixed stuffs to be em- red by the needle, is possibly as early in use e open frame, and this latter was well in mediæval times and even before then. n essential of pillow-lace making is the means of holding in fixed places the little threads as they are being plaited and intercrossed according to the patterns required. This, I think, implies a necessity of pins of some sort. Now, before metal pins were in common use, we had rather the reverse of this process. Instead of the balls of thread being pendent, free to be thrown over the other, and thereby to twist and plait threads into patterns, we saw that balls or "bowys" of thread were, in the 15th century, placed upon fingers, and thus were kept in fixed position, the loose threads coming from them were plaited and twisted. But in pillow-lace making it is the loose threads from the bobbins which are fastened on to the pillow, and the bobbins, with their balls of threads, are constantly thrown about.

XIII. The process of making lace on the pillow is very roughly and briefly, as follows:—A pattern is first drawn upon a piece of paper or parchment. It is then fastened to the pillow. The pillow or cushion may vary in shape. Some lace-makers use a circular flattened pad, backed with a flat, circular board, in order that it may be placed upon a table. Other lace-makers use a well-stuffed round pillow or short bolster flattened at the ends, so that they may hold it between the knees. On the upper part of the pattern are fastened the ends of the threads from the bobbins. The bobbins thus hang over the pattern. The lace worker must be versed in the knowledge of where her fixed points are to be. These fixed points rule the way in which the plaiting and twisting shall follow the pattern. Into these points she puts her pins, as she comes up to them in the course of her work. They are, in lace of simple pattern even, so close together that a dense forest of them is soon massed into a very small compass. Without attempting to convey an idea to you of the growth of such

FIG. 6.

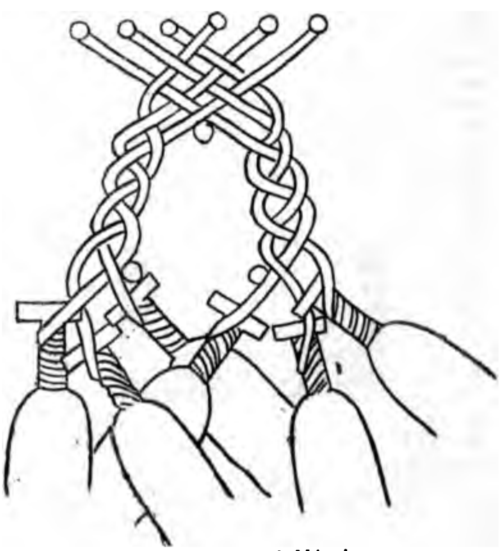


Diagram showing six bobbins in use.

a forest, I will merely take a simple form, and endeavour to show you how, say a triangle, might be worked in pillow lace. These fixed points are

of lace ought to know something of how it was made. A realisation of the pains and troubles expended and caused in producing it should increase our appreciation of it. We may regret the tremendous amount of labour. Still, whether we regret it or not, a piece of lace is a record—proper or improper, but, nevertheless, a record—of labour and time expended. And expenditure of labour and time, devoted either to the production of an ironclad or a bit of lace, seems, I think, worth that recognition which a knowledge of it forces upon us.

XV. You will have remembered the "purled" edges of plaited thread and silk, and the "merletti a piombini," in making which pins became necessary. Almost coincidently with the development of the "merletti a piombini," the rapid manufacture and use of metal pins seems to arise. A few years ago, the Commissioners of Patents published some abridgments of specifications of patents. And as regards pins, some interesting facts are stated, which are worth quoting:—"Pins formed of wire seem to have been unknown in England until about the middle of the 15th century, before which time they were larger than the present pins, and were made of boxwood, ivory, bone, and some few of metal." In Richard III.'s time, about 1483, there was a prohibitory statute against the importation of pins. Queen Catherine Howard is said to have imported them into England about fifty years later, and at this time Henry VIII. sanctioned an Act to regulate the "true making of pynnes." They were to be well pointed, with heads firmly soldered on to the stems. The price of them was not to be more than 6s. 8d. (or say, about 80s. of our money) per 1,000. Though used as dress fasteners, it is evident, from their then value, that pins cannot have been at all plentiful. The manufacture of them seems to have been of foreign origin, and when once started, it developed fairly rapidly. On the Continent, in Italy, Germany, Spain, and France, perhaps, pins became almost sufficiently

that the supposed bobbins are
case, however, assuming that M
drawn a pillow-lace maker at wor
not so conclusive on the matte
designs by Parasole, published a
16th century. On these is a s
numbers of leaden bobbins to be
patterns. Some require 18, othe
bobbins. Fig. 5 supplies us with
sort of plaited and twisted thread-
we are considering.

XVII. Judging from some sligl
mens of nearly similar work, I th
the plaited lines in it were plait
lengths. When a sufficient s
worked, then the lengths of thes
be wound round a sort of bobbin.
a few other bobbins containing
threads, a number like 12 or 16 b
would probably suffice for worl
without a multitude of small
conjecture is to some extent corro
mens in which we can trace a s
plaited fine cords. The quest
somewhat involved, and without
my idea as to such a method of wor
observe that four or five plaited
combination would be but a de
"purling," which was done witl
cords interplaited.

XVIII. Before entering into
white thread laces of maturer
like to make one or two rema
done with stiffened cords or e
in some respects allies itself w
work. This ornamentation in stifi
to be earlier, *quâ* importance of
plaited and twisted thread-work
under the name of "guipure,"
with gimp. Gimp is a small cor
whipping round a narrow strip
a small bundle of threads, or a
of silk or flax, and sometimes li

ısonably called "guipures," perhaps, greater portion of the gold laces extant ter the manner of 17th century pillow-g, and are not therefore, as the true is, dependent upon the ductile ic of gimp or wire for retaining their

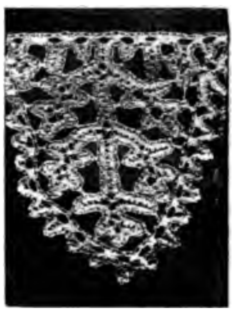
turning to pillow-laces proper, I wish ur attention to the way in which plaited white thread lines developed lines. An early instance of this we n this specimen (Fig. 7), which dates

Fig. 7.

isted thread-work known as "Merletti a Piombini." About 1560.

ıd of the 16th century. Another de-ɔf these flat portions of plaited work may this specimen (Fig. 8). So flat and

Fig. 8.



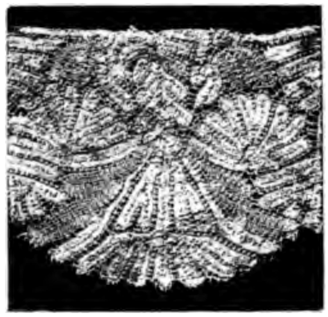
"Dentelle" of pillow-made lace. Late 16th or early 17th century.

work here that it looks almost as though linen had been used, and from it had ɔut the various forms. However, all ;ed and twisted thread-work done upon Somewhat similar to this in respect of he *passements au fuseau* used in France y 17th century.

u will, in the two recent specimens, have hat the flat portions resemble narrow tapes. Here is another specimen in ıt might be called a tape treatment is rent (Fig. 9). We have, therefore, soon period in early twisted and plaited ;e-making, when means had been r rendering broad and narrow forms, avy lines. In my last lecture I referred loyment of tape for making ornamental ace. A specimen of tape lace, with a meshes, lies on the table.

he art of pillow-lace making was not confined to geometrical patterns as was that of needle-point lace-making. Curved forms, almost at the outset of pillow-lace making, seemed to have been found as easy of execu-

Fig. 9.



Flemish pillow lace. 17th century.

tion. One reason for this, no doubt, is that the twisted and plaited work was, as we have seen, not constrained by a foundation of any kind. The plaitings and twistings gave the workers a greater freedom in reproducing designs. They could be intertwisted between the fixed points of the pattern with comparative facility, whereas, as we remember, the first needle-point lace workers began their lace with a framework of rectilineal lines. Still the pillow-lace worker did not in the matter of pattern proceed altogether faster than the lace worker with a needle. They virtually kept an even pace side by side. If anything, the pillow workers seem to owe more to the designers of patterns for needle-point lace, than otherwise.

XXII. About the early 17th century, important designs for plaited and twisted thread-work were produced. Of such I have a specimen to show you. It is a bed-cover, about 4 ft. 5 in. square. Fig. 10 shows a quarter of the design. The

Fig. 10.

Corner of a bed cover of pillow-made work. 17th century. Flemish.

design is chiefly composed of double-headed German eagles, surmounted by a Germanesque crown, and of insignia of the order of the Golden

Fleece. In the South Kensington Museum it is described as being made of "tape guipure." But this clearly is a misnomer. There is no gimp in it; neither is there tape in the accepted sense of the word. Although no doubt made in separate portions, afterwards fitted and fastened together, the whole was plaited on the pillow. A revised edition of the catalogue of the lace collections at South Kensington will, I hope, shortly correct the errors I have pointed out. But there is another question of interest attaching to the existing description of this fine bed-cover. It was bought by the Kensington Museum from Mr. J. C. Robinson, who had acquired it in Spain. Its proprietor, a member of a noble family, had a history that it was of Spanish workmanship, and had belonged to Philip IV. of Spain. Decorated bed-covers were in the time of that king much affected by wealthy Spaniards. But this fact, and the legend, have not convinced me that it is of Spanish workmanship. Because Frenchmen like Stilton cheese, and because we can buy good Stiltons at Chevet's, in the Palais Royal, we don't decide that Stiltons are made in France. In my first lecture I quoted incidents strongly tending to show that Spain had never been a country of importance in the making of lace—at least, at so early a date as that of this bed-cover. Spain published no lace pattern books. Her archives are replete with records of imported laces. She appears to me to have been as a great political and commercial power, unlike artistic and industrious Italy and Flanders. She may have been more like France, though perhaps less artistic; and France, even in the early 17th century, had little prestige in making laces. France later on acquired a renown, when she, or rather her King and Minister, established lace-making centres. I have not yet found out that Spain took analogous steps towards promoting the art of lace-making. Indeed, as times went on, her political and commercial power declined with apparently no immediate compensating resurrection of artistic industry. Now, Flanders and Spain, during the 16th and part of the 17th centuries, were under one Government. From Flanders, or as they are called Spanish Flanders, Spain imported most of the laces she wanted. Looking to the excellent completeness of this bed-cover, it seems to me to have internal evidence of being the work of Flemish lace-makers. Had it been of Spanish workmanship we should surely have had other specimens more peculiarly Spanish. And we might have expected to have heard of distinct Spanish laces, just as we have Points d'Alençon from France, Valenciennes, Mechlin, and Brussels laces from Flanders, and Honiton from England.

XXIII. For reasons slightly like these I have given in respect of Spain, not having been a lace-making country of importance, I am disinclined to believe in the well-known record, that a native of Nuremberg, Barbara Uttmann, invented in 1561, pillow-lace making. Her tomb in the churchyard at Annaberg, is a construction apparently of the present century. The people who erected it have inscribed upon it, "Here lies Barbara Uttmann, died 14th January, 1575, whose invention of lace in the year 1561 made her the benefactress of the Hartz Mountains." The sort of work which she is said to have made and taught to the people was a species of knitting. She assisted in this by certain refugees from Fland It is quite possible that she may have made sort of purling or even little borderings insertions like the "merletti a piombini" Venetians. But since the Venetians direct fluenced the Flemish, Barbara Uttmann's ad of Flemish work can, I think, hardly be call invention. I mention this point in connectio German laces, which by the way have not ac any artistic reputation, since an idea seems to got about that Barbara Uttmann was an ori inventress. Early Flemish edgings are simi the Venetian "merletti a piombini."

XXIV. We need perhaps trace the develop of "brides" or tyes and other details in pillow making. The history of them would be simi that I gave in respect of needle-point work.

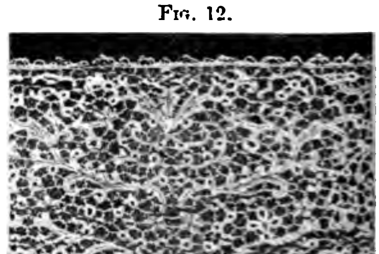
XXV. As I have before remarked, design pillow lace very much followed that in nee point; and this we may see by comparing two specimens (Fig. 11 and 12). In both spe

Fig. 11.

Venetian needle-point lace.

mens we have the scrolls held together by The tyes are ornamented with little "picots," loops, and fillings-in, or "modes," are notice in both. In the pillow lace (Fig. 12), howe

Fig. 12.



Pillow-made Lace. 17th century.

there are no such raised masses as those of com button-hole stitched work which we saw in needle-point specimen. The general appear this specimen is quite according to a piece of Ve tian scroll pattern, although it is flatly wo Much of this scroll work, sometimes with tyes sometimes with grounds of meshes, was done the pillow, both in Italy and Flanders. The

aen I showed you may, perhaps, be Italian. however, is a specimen (Fig. 13) presumed Flemish. A great deal of this sort of lace

FIG. 13.

-made lace, "à brides." Flemish. 17th century. Sometimes called "Point d'Angleterre."

imported into England in the middle of the century, and went under the name of "Point gleterre."

VI. The real English lace of this time commonly known as bone lace, and was ntly so-called because it was made with bobbins. It was a lineal descendant of purling" of Chaucer's time, and the l and twisted thread trimming to Queen eth's ruff. We may see border lace, ly bone lace, sculptured on the tomb dy Doodridge, at Exeter, and upon other nents of the 17th century elsewhere. Such vas allied in style of make and design Venetian "merletti a piombini." Bone as the name by which most English pillow ade during the 17th century was known. In s II.'s time its manufacture was of sufficient tance to demand Parliamentary attention. We een influenced by Flemish pillow laces, and no doubt, doing our best to imitate them. ur English imitations were not fine and c enough to please noble and wealthy people, accordingly, as in other countries, obtained supplies of lace from abroad, and chiefly from ers. Still it was thought wise to stimulate ne-lace manufacture by stringently prohibit- portations of Flemish lace. To evade these ent prohibitions, and to enable English lace s to supply the country with the esteemed sh laces, or as they had been called, "Points leterre," our manufactures obtained the es of Flemish lace-makers, and induced some tle in England. This took place about 1662, which closely corresponds with the time France, by the help of Venetian *employés*, stablishing her lace-making centres. France, ver, more under paternal government than tutional Parliamentary England, seems to been the more successful of the two ries in obtaining celebrity for her newly ed industry. "Points d'Alençon," I am , have always been more prized than Honiton pillow lace. Bishop Berkeley in the early 18th century makes a remark upon the relative values set upon English, French, and Flemish laces. "How," he asks, "could France and Flanders have drawn so much money from other countries for figured silks, lace, and tapestry, if they had not had their Academics of Design." England has, however, now gone beyond France in the number of her Schools of Art, and through a solid progress of imperial and local co-operation she may soon be able to boast of a larger number of provincial museums, which in an important sense may become academies of design for the benefit of our manufactures.

XXVII. But we must return to our inquiries as to the development of pillow-lace making. We were particularly discussing pillow-made scroll designs held together by brides. Turning to pillow laces with grounds of small meshes, I have here a specimen of such work, and one in which a floral and more naturalistic treatment is noticeable (Fig. 14). Of about the same period—that is, I

FIG. 14.

Pillow-made lace, "à réseau." Flemish. 17th century.

think, near 1660—we have pillow laces in which other ornaments, such as heraldic devices and figures, were introduced. This (Fig. 15) is, perhaps, an Italian pillow lace of this period.

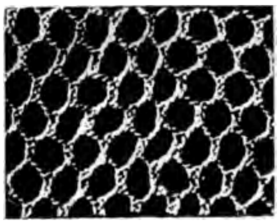
FIG. 15.

Pillow lace, with ground of meshes. Italian or Flemish. 17th century.

XXVIII. On the table are examples of Italian pillow lace, with a scroll pattern of conventional drawing, done with a ground of meshes. I am afraid that time will not allow me to trace the development of the various plaitings used at different lace-making centres for the meshed grounds or *réseaux*. Generally speaking, I do not think that these *réseaux* came to be made before the

17th century. The Flemish makers appear to have excelled in producing them; and there are three important classes of them which I will now proceed to show you. We may take the Mechlin first. Mechlin, as a lace-making centre, dates from early in the 17th century, at least. Here are two specimens of characteristic Mechlin laces; the one with a close design, in which appear boys blowing horns, and carrying bows and arrows, is in the style of Louis Quatorze ornament, while the other, with a ground sprinkled with little roses, is some 70 or 80 years later. A feature in Mechlin lace is the thread or *cordonnet* which outlines the pattern; and another is the particular plaiting of the threads forming the meshes (see Fig. 16). When a

FIG. 16.

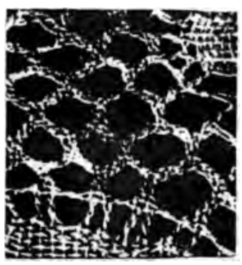


Enlargement of meshes in Mechlin lace grounds, showing the two plaited and four-twisted sides in each hexagonal mesh.

cordonnet and this sort of mesh appear in a pillow-made lace, it is safe to consider the lace to be of Mechlin manufacture.

XXIX. The second of the important pillow laces is the Valenciennes. I will show you the meshes first of all. You here observe that the threads composing the sides of the mesh are plaited (see Fig. 17). No sides, as in the Mechlin

FIG. 17.



Enlargement of meshes in Valenciennes laces, showing the plaiting for all sides of the mesh.

meshes, are merely of twisted threads. No outlining thread or *cordonnet* is used in Valenciennes lace. The pattern is flat, as you see it in this specimen of late 17th century. (Fig. 18.) This Fig. 19*a* is a specimen of later date, after the middle of the 18th century, when the patterns for lace consisted of flowers and buds sprinkled upon the ground, as we saw it, not only in the Mechlin lace, but also, during our last lecture, in designs for Point d'Alençon. The second specimen 19*b* might be called a piece of "Fausse Valenciennes." The work is less regular, and the meshes are differently plaited. The third specimen, 19*c*, is a piece of century Valenciennes lace, made probably a and is a much more wiry and less soft-

FIG. 18.

Valenciennes pillow lace.

lace than the old "Vraie Valenciennes" of the century. An interesting example of a French done in the style of Valenciennes, with ill-

FIG. 19.

a

Pillow lace.
"Vrai Valen
Late 18th ce
French.

b

Pillow lace.
Valencienn
Early 18th c
French.

c

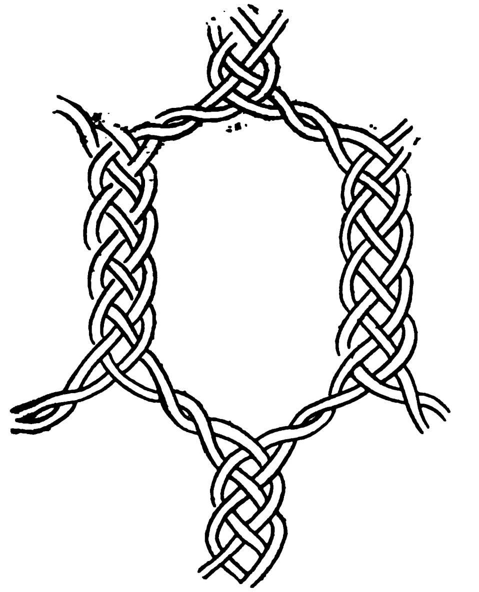
Pillow lace.
Valencienn
Made at Yp
Flemish.

Scripture figures and legends, lies on th There are indications that the date of its pro was about the first ten years of the 18th ce

XXX. Now a third important pillow-m is the Brussels. In Brussels laces we fin sorts of designs. Some are placed on a work of brides, others upon meshes. The of the meshes of Brussels lace is different fr of either Mechlin or Valenciennes (see Fi The plaited side of a Brussels mesh is long that of a Mechlin mesh, otherwise these tw sorts of meshes are much alike. But a distinctive mark of Brussels pillow lace

...ed plaited *cordonnet* or edging which marks ...e patterns. This you might notice in this speci... ...en (Fig. 21a). This piece dates from about

Fig. 20.



...argement of mesh of Brussels ground, showing the four-twisted and two-plaited sides in each mesh.

...e commencement of the 18th century, and the ...ttern is remarkable as being a pillow-lace ren...ring of an Alençon design. The second specimen ...ig. 21b) is of the same period. It is a mixture

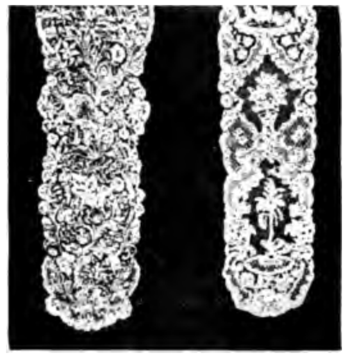
Fig. 21.

Pillow lace. Brussels. 18th century.

Needlepoint and pillow lace. Brussels, 18th century.

...needle-point and pillow lace. The details are ...orked with a needle and the ground is of pillow ...ake. The two specimens shown in Fig. 22 are ...rtions of lappets. Fig. 22a is again an example ...an adaptation of a Point d'Alençon pattern ...ndered in pillow lace. The rough indications of the variety of devices introduced into this lappet do poor justice to the extremely elegant manner in which the threads themselves have been plaited to represent the forms of flowers, birds, variegated

Fig. 22b. Fig. 22a.



Lappets of pillow-made lace. Brussels. 18th century.

"modes," &c., actually shown in the original lace. The second lappet (Fig. 22b) is of close floral design, and this close arrangement of flowers and leaves, broken by small interspersed mesh grounds, has been considered to be a mark of early Devonshire lace. But the workmanship is precisely like the Brussels lace, and I am inclined to assign to such piece a Brussels rather than a Devonshire origin.

XXXI. Of the various methods used by Brussels lace-workers in executing portions separately, of bringing them and fixing them together to form a whole piece, as well as of the many combinations of needle-point and pillow-lace making, I am sorry not to be able now to speak. Such details would, if justly treated, supply matter enough for a separate lecture. The specimens upon the table are a small index of the variety of patterns worked by the Mechlin, Valenciennes, and Brussels pillow-lace makers, and some of them are, as you will see, of beautiful finish in workmanship, as well as of intricate design.

XXXII. My object this evening has been to place before you a summary of incidents respecting lace made on the pillow, and I hope I have to some extent shown you that it is a branch of the art of lace-making originating from a source different from that of needle-point lace-making, and yet, in the progress of its design and pattern growth, becoming much allied with that of needle-point lace.

MISCELLANEOUS.

ON A NEW SCREW GAUGE FOR ELECTRICAL APPARATUS.*

By William Henry Preece, F.R.S.

It is very desirable to establish a gauge for the manufacture of various small screws used in the construction of telegraphic and electrical apparatus. Sir Joseph Whitworth, in England, and the Franklin Institute in America, have done this for the bolts and screws used in mill-work and engineering generally, but no one has extended either system to the finer work used in those numerous practical applications of electricity that are

* Read before the British Association, at York, Sept. 1881.

now becoming so important. Gauges and screw-plates are now as numerous as the makers engaged in the trade. Nettlefold's sizes of screws are, perhaps, those best known, but they are worked to a special gauge, starting from a diameter of 0·5 inch, which is numbered 32, and which has no known relation to any other gauge used in telegraphy. Whitworth's standard gauge for watch and instrument makers has not yet been adopted. The microscopical gauge is confined entirely to microscopes. There is, in fact, no fixed pitch, no form of thread, no recognised number of threads per inch, no gauge based on practice and experience. Hence interchangeability for repairs is impossible, and the difficulty of applying for materials from abroad becomes very great. Screws are now generally supplied as "per pattern."

Sir Joseph Whitworth has remedied these defects in the larger forms of machinery, and, at the present moment, there is not a ship in her Majesty's Navy which is not supplied with the same screws and the same threads. Many large engineering works, such as those at Crewe, are in the same happy condition. Sir Joseph Whitworth carried his proposed standards for taps and dies to ·100 inch diameter, having 48 threads per inch, but his gauge has not come into general use for sizes less than ·250 inch diameter. I have placed myself in communication with most of the principal electrical apparatus manufacturers in England, and they have not only expressed their willingness to accept a well-conducted gauge, but have concurred in the view I have indicated of the present unsatisfactory condition of the question.

It fortunately happens that, from the point where Sir Joseph Whitworth and the Franklin Institute start in one direction, we can move in the opposite direction, so that, not only can the two gauges be made continuous, but though necessarily different in their applications, they can really be made uniform in their character. Indeed, the Whitworth gauge might itself, with slight modification, be extended.

It is only necessary for us to consider angular threads; square threads do not enter in such small work.

The Whitworth gauge specifies that the pitch of angular threads shall be equal to the depth which involves an angle of 55°, and that the top and bottom shall be rounded off to $\frac{1}{6}$th of the depth.

Screws of a diameter of $\frac{1}{4}$ in. (or No. A in the B.W.G.) have twenty threads to the inch. This is the starting point of the American gauge, and both deal with increasing diameters. I propose to start from the same point, but to work in the opposite direction, dealing with diminishing diameters. Thus my starting point is of the new No. 4 centimètre gauge, ·251 in. diameter, having twenty threads to the inch.

The exchange of apparatus between this and Continential countries is now so general, that the adoption of the French decimal metrical system is well worth serious consideration. This is felt so much that in nearly every table of wire gauges the dimensions both in parts of inches and metres are given. The adoption of the metre as ths unit length would secure adoption of the gauge abroad. The use of the inch as a unit leaves us in that singular insular position, to which Sir William Thomson pointedly referred in Section A. the other day.

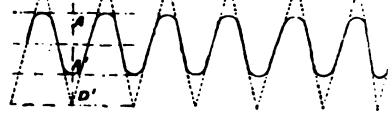
There are two dimensions besides the form and nomenclature to be considered, viz., the diameter of the screw and the number of threads per unit length. I suggest that the nomenclature be that of the wire gauge. The form I again refer to.

For the first dimension we might adopt a special number, as is done in the trade now, or we may take the same number for the screw and its diameter in *mils* or in millimètres, or, as I propose, we should adopt the new centimètre gauge recommended for adoption by the committee of the Society of Telegraph Engineers (December, 1879).

For the second dimension I propose to take the 5th multiple of the number of the screw in the [centi]mètre gauge as a factor. Thus No. 5 screw [will have] twenty-five threads to the inch, and its diam[eter will be] ·225 in. No. 8 screw will have forty threads [to the inch,] and its diameter will be ·161 in., and so on, a[s shown in] the attached table, which embraces nearly all [the sizes] now in use. In all other gauges the number [of threads] per inch is perfectly arbitrary. In fact, at pr[esent,] with the same gauge and the same kind of [screw, the] number of threads per inch varies.

Thus, if there is any value in my suggestion [we shall] have a simple nomenclature and a fixed gaug[e, like] that already adopted for wires and plates, [easily] remembered.

The attached diagram gives an idea of the [form] of the thread recommended by me for consider[ation. It] has been carefully prepared with existing th[reads, and]



due regard has been paid to the essential requ[irements of] strength, durability, and friction, but, in the op[inion of] some, the depth of the thread is too deep in pr[oportion] to the diameter of the screw. In the small scr[ews used] for telegraphic and electrical purposes we need [not con]sider the difference of metals employed.

There can be no doubt that a recognised [gauge,] with a distinctive name, based on a simple [system,] and easily remembered, and supplied by [such a] house as that of Whitworth will soon take ro[ot, and] be generally accepted, if stamped with the r[equisite] authority.

I submit that the subject be referred to a co[mmittee] of this Section for consideration and examina[tion, so] that a new gauge may be recommended for a[doption] with all the authority of the British Associatio[n.]

PROPOSED TELEGRAPH SCREW GAUGE.

Gauge.	Threads per Inch.		Diamete[r.]	
	Whitworth.	Telegraph.	Inches.	M[illegible]
4	20	20	.252	
5	} 24 {	25	·225	
6		30	·201	
7	..	35	·180	
8	32	40	·161	
9	..	45	·144	
10	40	50	·129	
12	48	60	·103	
14	..	70	·082	
16	..	80	·066	
18	..	90	·053	
20	..	100	·042	

Patents in Turkey.—General Patent-laws [have] lately passed and promulgated in Turkey a[nd ...] The Turkish Patent-law is substantially a copy of [the ...] and German systems. Any person may take a [patent on] deposit of drawings and specifications. Longest t[erm of] patent fifteen years; annual tax, 18 dollars. Th[e invention] must be worked within two years from the date of [the patent.] The penalties for infringement and the proceedi[ngs are the] same as in European countries. In Liberia th[e applicant] must be the inventor, or must have lawfully ac[quired the] invention from the inventor. Drawings and sp[ecifications] must be furnished. The Government fee is 50 d[ollars. The] invention must be worked within three years after [the date] of the patent.

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CEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE ART OF LACE-MAKING.*

By Alan S. Cole.

:URE IV.—Delivered May 9th, 1881.

as to styles of design in hand-made lace. tional patterns. Sketch of the development of ions for knitting and weaving threads to imitate Differences between machine and hand-made Modern hand-laces at Burano, Bruges, on, &c.

uis evening, in my concluding lecture, I pro-take a passing survey of a few of the principal n the history of the art of lace-making, to [have called attention.

n tracing the history of the two great is of lace-making by hand, needle-point and I have sought to establish a gradual develop-f the art, rather than to insulate it by itself, regard it as some freak of handicraft of unac-ole spontaneous birth.

Needle-point lace-making is distinctly a f embroidery; pillow lace-making, a lineal lant of plaited thread-work and fringes. Both owe such fame as they have acquired to the and variety of form imported to their pro-s by the genius of designers of patterns. artists considered free threads (looped, and twisted) as a fitting vehicle for repre-on of patterns, a higher career for the ment of looping, plaiting, and twisting com-. This career shows first signs of develop-ı Venice early in the 16th century. From fancy, fashion, imitation, and other such ely influences, spread the newly-developed thread-work to other countries. In each r where the art happened to become im-l, the special circumstances of the various gave it some sort of character, either in a or a weak degree.

Thus, the laces of Flanders, in their first of growth linking themselves to those of nd Venice, later on are entirely different in ance from their ancestors. This is parti-so as regards the Valenciennes, Mechlin, ussels pillow lace. French needle-point gain, have, as we have seen in the Point con, a specialty in appearance which, without the gradual steps by which we have traced them from the "Punt in aria," might be said to have no likeness to their antecedent Venetian parents. English laces, on the other hand, are not so markedly detached from the general family. On the whole, they closely resemble Brussels, Mechlin, and Valenciennes laces, though at the same time Honiton lace, with its prettinesses of floral devices, may claim to stand by itself. In respect of other countries, the methods of making lace are similar to those involved in one or other of the categories above specified. The designs of such laces are either direct imitations of older laces, or else are of so unmarked and general a character as to lose themselves in the primitiveness of design, which may be said to be the common property of all form-depicting countries.

V. I have prepared a diagram to show, in a general manner, the periods of different styles of patterns in lace-making (Fig 1, p. 800). These extend from 1540 to the present time; and I have roughly divided them into seven epochs, some of them overlapping, preceding, and succeeding ones. Upon the diagram you will observe black bands of varying size. The first one is intended to indicate the growth and progress of needle-point lace-making; the second, that of pillow-lace making; and the third, that of machine-made lace.

VI. In respect of hand-work, I think needle-point lace developed itself sooner than pillow-made lace. But the difference in data is possibly so slight as not to be worth close inquiry. Needle-point, at starting, took the stronger growth of the two perhaps. It seems to have reached a climax from between 1650 to 1720. Then it declined, and from 1790 to the present time it seems to have preserved an even life. It is not of such strong life as that of either pillow-made or machine-made lace. As regards pillow lace, it appears to have expanded in vigour, as needle-point declined, so that its period of supremacy might be placed at from 1680 to 1780. From 1790 to about 1850 the annual quantity of pillow-made lace became smaller perhaps than formerly, but soon it revived, and now seems to be larger. As to machine lace, that may be said to have begun its life with the machine-making of nets about 1770, and in a hundred years to have become probably more than a hundred times as important in quantity as needle-point and pillow lace combined.

VII. We have discussed, principally in their respective classes, those laces which have celebrity for beauty of pattern, as well as for fineness of workmanship. And we have seen that these come from Venice, Alençon, Valenciennes, Mechlin, Brussels, and I think it would be unpatriotic if we did not add Honiton. But, now, we should give a share of attention to other less celebrated laces, and I will therefore show you a few specimens of them. Of German provincial laces—evolutions, as we may take them to be of Barbara Uttmann's 16th century work—there are two pieces, both from the district of the Erzegebirge (Fig 2, p. 801). Although made recently, the patterns displayed in these laces might almost be of any date. They are, evidently, traditional patterns, handed down through generations of lacemakers, without much modification since the time when they were first made, which was, probably, in the 17th century. The upper specimen, with its large circular device and

quaint plant form, is similar to some lace made in Holland. The lower is what would be called a sort of "torchon" lace. The principles of design in this are simple, the pattern consisting of various lozenge shapes. It is not unlike that used by the peasants of Dalecarlia, in Sweden, who, for some hundred and fifty years, have made this [lace], only in coarser thread than that used [by the] Germans.

VIII. Patterns, somewhat similar, have bee[n made] by the inhabitants of the Island of Crete. T[here is] a large collection of Cretan laces at the

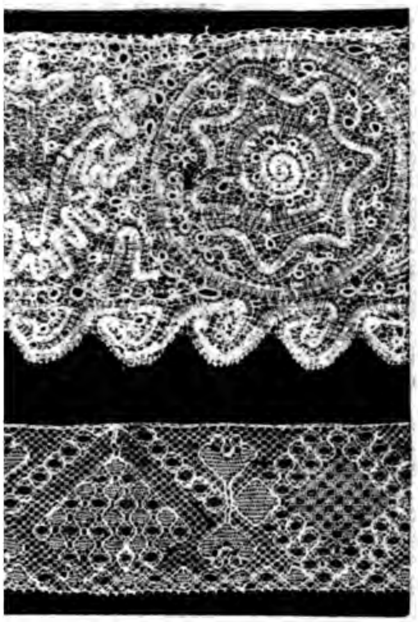
FIG. 1.

	I.	II.	III.	IV.	V.	VI.	VII.
DATE...........................	1540 TO 1590.	1590 TO 1630.	1620 TO 1650.	1650 TO 1720.	1720 TO 1780.	1790 TO 1851.	1851 TO 1881.
STYLE OF PATTERN ...	Geometrical forms as worked in Reticella and Punt in aria. No "bride" or meshed ground used.	Introduction of floral and human forms, and slender scrolls, held together by "brides" or tyes.	Development of scrolls, and elaboration of details in scroll patterns. Commencement of use of meshed grounds.	Arrangements of detached ornamental details. More naturalistic imitation of flowers and pictorial representation of figures and portraits, and considerable use of ground of small meshes.	Designs composed of small details sprinkled over meshed grounds, and perpetuation of preceding patterns of 1690 to 1720. Use of machine made net commenced about 1720.	Perpetuation of some few traditional patterns, and mixture of conventional and naturalistic details. Repetition of motives. Loss of freshness in design.	Production of designs especially considered in regard to their reproduction in machine laces. Revival of old patterns. Mixture of all preceding styles.

Kensington Museum. Little, if anything, is known of the origin of lace-making there. It has a likeness in many respects to the quaint pillow laces of South Italy. Crete has been intimately connected with Venice, and very probably Cretans learnt the art of lace-making from Venetians and other Italians. The workmanship displayed [in] Cretan laces is remarkable. The [...] and twist threads is almost as good [as] artistic lace-makers at Brussels and Mech[lin] Cretan laces are chiefly of silk. The pat[terns of] the majority of the samples at the South K[ensington]

um are outlined with one, two, or three ıloured silken threads, which form the of the lace. As a rule, the motives of n lace patterns are traceable to orderly

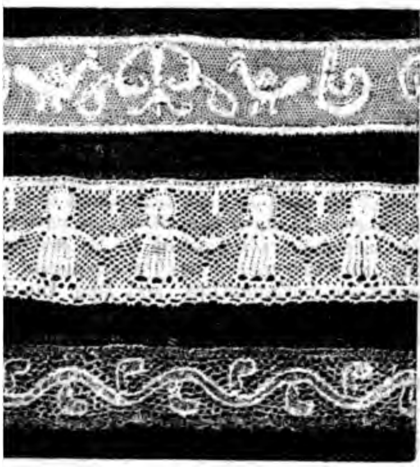
FIG. 2.



German pillow-made laces. 18th century.

ent and balance of simple symmetrical etrical details, such as diamonds, triangles, olygonal figures. Sometimes the patterns r origin to untutored imitation of a r leaf. Here are two specimens of the ce (Fig 3, *a b*). I have specially selected

FIG. 3.



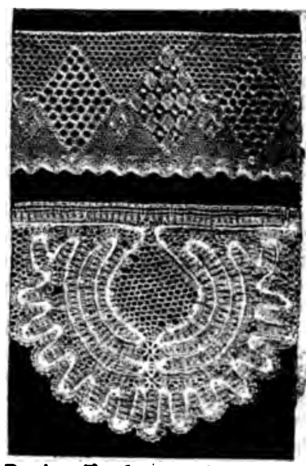
laces from South Italy (18th century), and from Crete, Early 18th century.

one of the more ambitious of the Cretan design, that in which we have a line of stately figures, holding hands, strongly suggestive of those delightful persons which are cut out of paper for infantile delectation. The specimen beneath is of silk. Lace, I believe, is no longer made in Crete. The specimen in which two birds appear, together with forms, the meaning of which I cannot elucidate, is of South Italian lace (Fig 3 *c*).

IX. From Italy we may cross Bohemia, and place ourselves in Central Russia. Pillow lace has been made there for over a hundred years, by peasants of different districts. Following in the wake of fashion of Western Europe, Russia, under Peter the Great, towards the end of the 17th century, took up with lace-making. A silk lace factory was then established, but no cultivated artistic spirit ever raised the productions of this factory to special distinction. The patterns now used by Russian lace-makers bear all the stamp of traditional provincial patterns used by different European peasantries. Lace is made in Russia in the districts of Belev, Volozda, Riazan, and Mzensk. This scalloped border (Fig 4 *a*) is made in the Beler district. Its

FIG. 4.

b



a

Russian pillow laces. 19th century.

big meshed ground is plaited similarly to Italian and Valenciennes grounds. The border (Fig 4 *b*) with small vandyked edge reminds us of the style of German and Swedish "torchon" lace. It is also suggestive of a lace made a few years ago at Ripon, in Yorkshire.

X. Thus, over a great area in Europe, we may judge how lace-making of nearly uniform style of design has spread itself. It is a humble and rather precarious means of support for peasants, and in this condition it cannot be expected to rise to any status of artistic importance. Sometimes a little stimulus is given to the efforts of one set of peasants, sometimes to another, as for instance, at the present time, when fanciers of hand-made lace purchase in fairly considerable quantities trimmings and borders of Russian lace.

XI. From specimens, the origin of which is identified with various countries, we may pass to lace-makers themselves, their training to the

two instances above referred to. Threads used for lace are made in a manufactory distinct from the lace manufactory. A like arrangement exists in respect of hand-made laces, that is to say, that the lace-worker is not also her own spinner of thread, though three hundred years ago, the spinner of threads, with her distaff and wheel, would sit in the same room with the needle worker; but this association of two separate employments in time was broken up, and division of labour, a subject full of interest, and ultimately connected with the development of organisation in respect of manufactures, arose.

XIV. The present position of lace-workers does not appear to differ very materially from what it always has been, and some interesting facts concerning it have been kindly supplied by Mrs. Percy Smith, in regard to Belgian pillow-lace workers at Bruges. Lace there is made by children and by adults. The children begin work in convent schools, when they are as young as five or six. They first make a small "torchon" lace, smaller and less elaborate than specimen in Fig. 4*b* (p. 801), but of that character of work, in which you will not observe any subtleties of "modes" or fillings-in, like those we saw in the fine specimens of Brussels lace exhibited last Monday. Many of the young Belgian generation of artisan children are thus, early in life, grounded in the art of lace-making. This grounding takes up a principal part of their school-time, for whilst two hours a day are given to reading, writing, and arithmetic, the remainder of the day is devoted to lace-making. In a few parish schools, which are distinct from convent schools, lace-making is taught, but in a lesser degree than in the convent schools.

XV. As regards the class of lace-making women, the work by them is done in their cottages in the town. In summer you may look down long and wide back streets of the town, and see hundreds of women in groups of three, four, and five outside their cottages plying their bobbins most industriously. In winter if you walked down such streets you

agent, under penalty of a heavy G
which thus is a protection for desig

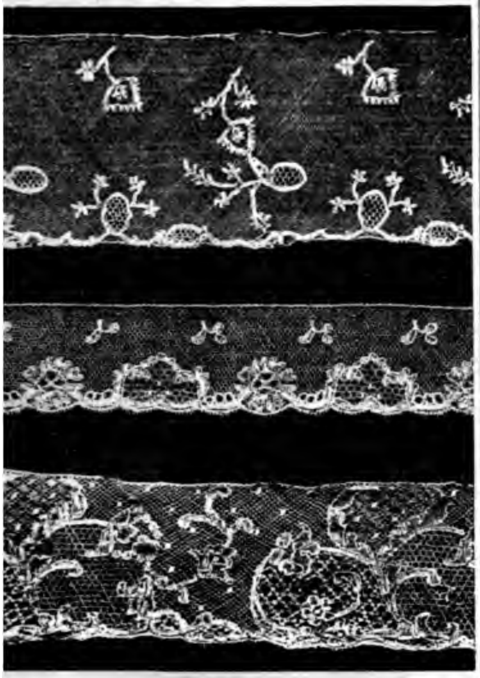
XVII. Now, as regards the de
remember how much a good rende
depends upon the skill of the pricl
mines where the pins are to be
twisting and plaiting proceed. I
instructors usually undertake to pri
but for the other body of lace-make
is done (at least, in Bruges) almo
one woman, whose renown as a pat
such, that, at the present time, she h
which will take her eighteen month

XVIII. Coming now to thread
workers, it is a curious fact that,
flax is grown in Belgium, the
machinery into fine threads is don
The thread, when made, however,
to be a pure flax thread, for the
admixture of cotton with it; an
a measure of hardness to the lace
quality which earlier laces, mad
spun thread, do not, fortunately, p
lace-makers have to use hand-spu
obtain it from the town of Alost,
spinners make the thread. This p
thread is used for the better quali
needle-point lace, specimens of wh
table. Work of such sort is done to
and its price, £12 to £15 per yar
four or five inches, renders it scarce

XIX. I now wish to offer you a fev
styles of patterns used in the United
laces of Buckinghamshire and Devon
perhaps amongst English laces. I
(5, p. 803), showing three sorts of Bu
lace. In the first one (*a*) we may not
fillings in. This variety gives the
lace to such specimens. It is o
work, but an adaptation of Me
Kant," or sampler lace, sent round
purchasers to show the variety of
the lace-makers happened to be

lled Honiton guipure, or pillow lace with is a distinguishing characteristic of this class nglish lace. Sometimes a costly specimen of ton lace is made for a special purpose, and

Fig. 5.



English pillow laces. 18th century.

, according to the requirements of the person may have ordered the work, the lace is made better care than usual. Of such works we two important specimens, lent by Messrs. ward and by Messrs. Howell and James.

XI. Although private enterprise and courtly onage have essayed, and to an extent succeeded, nplant the art of lace-making in the United gdom, and although from time to time direct gn influences have been infused into it, as by gee Flemings in the 17th century, a practice he higher ornamental phases of the art has r fairly and successfully rooted itself here. re artistic lace-making had fairly developed le later years of the 16th century, England been gradually slipping away from Papal emacy. Convents and monasteries, in which ches of fine art have ever been fostered, st disappeared from England, and no in-tions so strict for artistic and disciplinarian oses succeeded to them. To a cause like we might assign the failure of England to me a leading producer of lace. A French-, who wrote in 1852 upon lace-making, gives, ever, a different cause, which is amusing. Grant-that if the product of all products, requiring e in its development, be lace, how, he asks, is ossible to find grace in England? Do you t proof of this, writes this Frenchman? Look, then, at an Englishman walking; look at him when he makes a bow; look at him as he takes a seat, as he enters a room, as he hands a cup to anyone, and so forth. The conclusion clearly is that the Frenchman was right—we were awkward, we had no grace, and so were incapable of making good lace. But now, remembering that such observations were made thirty years ago, when England, "perfidious Albion," was in her final stage of perfidy towards France, it will not surprise us much to find a vast and admitted improvement in regard to much of our lace-work. In the matter of machine lace, a subject we shall shortly touch upon, we may boast of as good quality of design and workmanship as exists anywhere; while for our hand-made laces, the specimens of Honiton pillow lace and Irish needle-point lace are surely re-assuring to anyone who is doubtful of British powers in this art. At the same time, in speaking of this Irish needle-point lace, called "lacet," I must tell you that the greater part, if not the whole of it, is produced in Irish convents. Of other Irish laces I may say that there are about eight so-called different sorts. But Limerick lace is a tambour embroidery, I think; Carrickmacross lace is a sort of cut muslin work; pearl tatting, or "Frivolite," is clearly neither genuine pillow nor needle-point lace, and the varieties of crotchet imitations do not of course belong to either of the two important branches of the art.

XXII. Some thirty odd years ago, Parliament voted money for the encouragement of normal schools for lace-making in Ireland. From causes which do not require discussion, the Governmental encouragement was withdrawn, after having existed for some ten years, and the schools are now closed.

XXIII. Lace is made by Irish peasants in their cottages and cabins. They work chiefly from traditional patterns. No inspection for instructive purposes, or for suggestion of new patterns is provided, save such as may be derived from the relations between lace-dealer and lace-maker. The peasants are left somewhat to their own devices, and so one does not look for much artistic work from them. The better Irish lace—lace which may rank with lace of the finer classes altogether—comes from the convents, where fine old patterns and well selected new designs can be re-produced.

XXIV. Returning once more to the Continent, we shall find, in France, Austria, and Italy, a considerable life in the making of lace by hand. It is a popular fancy to suppose that the art is dead. The patronage which the wealthy can and do accord to the art, stimulates the production of new works, and while such patronage is intelligently and discriminately extended, the art lives.

XXV. From Vienna come occasional specimens of needle-point lace-work. The extraordinarily fine collar of needle-point lace, a modern version of the raised Venetian Point of the 17th century, lent by Mrs. Alfred Morrison, was, I believe, made under the direction of a Viennese lace merchant, who employs Bohemian lace-makers. Putting aside the question of design, which in this over-elaborated collar has not the dignity of an Italian 17th century raised scroll point, you will see here an astounding combination of almost incredible minutiæ, executed with a perfection of

finish which rivals that displayed in earlier work. Needle-point lace is also made in France, exceptionally, perhaps, but still sufficiently to show that what has been done can be done again.

XXVI. In Italy a new departure has been taken in the making of hand-made laces, at the Island of Burano, near Venice. "This island, in the 16th and 17th centuries, was one of the principal seats of the celebrated lace manufacture of the Venetian provinces. The formation of the school recently established there, and the revival of the art of lace-making in Burano, arose out of the great distress which, in 1872, overtook its inhabitants. The extraordinary severity of the winter of that year rendered it impossible for the poor fishermen, who form the population of the island, to follow their calling. So great was the distress at that time, that the fishermen and their families were reduced to a state bordering on starvation, and for their relief contributions were made by all classes in Italy, including the Pope and the King. This charitable movement resulted in the collection of a fund of money, which sufficed to relieve the immediate distress and leave a surplus applicable to the establishment of a local industry, which seems to be not unlikely to permanently increase the resources of the Burano population.

"Unfortunately, the industry at first fixed upon, namely, that of the making of fishermen's nets, gave no practical result, the fishermen being too poor to purchase the nets. It was then that a suggestion was made by Signor Fambris that an effort should be made to revive the ancient industry of lace-making. Princess Chigi-Giovanelli and Countess Andriana Marcello were asked to interest themselves in and to patronise a school for this purpose. To this application those ladies yielded a ready assent, and at a later period Queen Marguerite graciously consented to become (as her Majesty still is), the president of the institution.

"When Countess Marcello (who from that time has been the life and soul of the undertaking) began to occupy herself with the foundation of the school, she found an old woman in Burano, Cencia Scarpanile, who preserved the traditions of the art of lace-making, and continued, despite her seventy years and upwards, to make "Burano Point." As she, however, did not understand the method of teaching, the assistance was secured of Madame Anne Bellorio d'Este, a very skilful and intelligent woman, for some time mistress of the girls' school at Burano, who in her leisure hours took lessons in lace-making of Cencia Scarpanile, and imparted her knowledge to eight pupils, who, in consideration of a small payment, were induced to learn to make lace.

"As the number of scholars increased, Madame Bellorio occupied herself exclusively in teaching lace-making, which she has continued to do with surprising results. Under Madame Bellorio's tuition, the school, which in 1872 consisted of the eight pupils (who received a daily payment to induce them to attend), now numbers 320 workers, paid, not by the day, but according to the work each performs. In this way they are equitably dealt with, their gains depending on their individual skill and industry.

"In Burano everything is extremely cheap, and a humble abode capable of accommodating a small family may be had for from 600 to 1,000 Italian lire. It is not a rare occurrence to find a young girl saving her earnings in the lace school, in order to purchase her little dwelling, that she may take it as a dower to her husband. Nearly all the young men of Burano seek their wives from among the lacewomen, and the parish priest reported last year facts which showed conclusively that the moral condition of the island, consequent on the establishment of the lace school, has improved in a very striking degree.

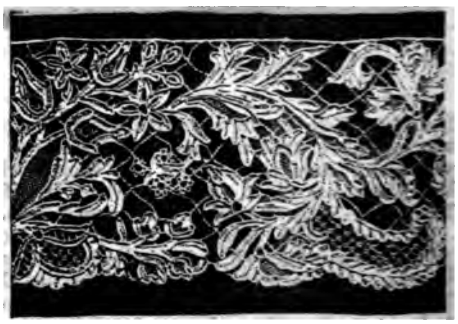
"The lace made in this school is no longer exclusively confined, as in the origin it was, to Burano Point, but laces of almost any design or model are now undertaken.

"In order the better to carry out the character of the different laces, the more apt and intelligent of those pupils whose task it is to trace out in thread the design to be worked, have the advantage of being educated by means of drawing lessons from professional artists.

"The 320 workwomen now employed are divided into seven sections, in order that each may continue in the same sort of work, and as far as possible, in the same class of lace. By this method each one becomes thoroughly proficient in her own special department, executes it with greater facility, earns consequently more, and the school on its part gets the work done better and cheaper (although of course cheapness must always be very relative)."

XXVII. Besides specimens of lace now made at Burano, on the table before us, I can show you two slides of the lace. The first (Fig. 6) is a needle-

Fig. 6.



Needle-point lace. Burano. 19th century (1879).

point lace, "à brides," with a marked cordonnet. It is rather in the style of so-called Argentan designs. The second (Fig. 7) is more in the style

Fig. 7.

Needle-point lace. Burano. 19th century (1879).

of 17th century Venetian needle-point lace, with a ground of hexagonal "brides" with "picots."

We have now to consider machine-made lace. And in approaching this section of my lecture, I must tell you beforehand that it is difficult to attempt to give a short description of the process. Of course, if we had had to discuss the mechanism of man, why and how his mechanism permits the manufacture of lace, in the same way that we may discuss the lace-making machine, the human machine would be the more wonderful of the two. Still, whereas I have devoted two lectures to processes of making lace by hand, and now propose merely to give a portion of a lecture to lace-making by machinery, you will not suppose that this determines the relative importance between the two branches of lace-making by hand and by machinery.

Mr. William Felkin has written a considerable work upon the lace machine. He shows that it is very much from the art of knitting that we trace the origin of the machine for making lace. Knitted caps and hose date in England from the end of the 15th century at least; as various Acts of Parliament testify. Knitted stockings, however, possibly from the difficulty of forming the heels and feet, seem to have been later, for Henry VIII. is said to have had, for ordinary wear, cloth stockings, "except there came from Spain by chance a pair of silk stockings." Even as late as 1610, "so unfashionable were young gentlemen commoners," that George Radcliffe, writing from University College, Oxford, to his mother, asks for a green baize table-cloth, "of which, if too little for my table, I will make a pair of warm stockings." But some 17 years previously to this, the town of Sheffield can claim the credit of having given from its trust funds 13s. 3d. to "William Lee, a poore scholler of Sheffield, towards the settynge him to the University of Chambridge and buyinge him bookes and furniture." This William Lee, who became a clergyman, was for some reasons expelled from his college (St. John's), where he held a fellowship. He appears to have married an innkeeper's daughter, and after the loss of his fellowship soon fell into extreme poverty. In his distress to find a source of income, his inventive faculties were called into play. The only support for his wife and child appears to have been derived from the sale of hand-knitted stockings. Sitting constantly with his wife, the scholar often fixed his attention on her dexterous management of the needles. In course of time he invented a mechanical contrivance, by which stockings might be more quickly knitted than by the hands. This is generally accepted as the first stocking-loom. The news of this invention, which was at once recognised as a formidable rival to hand-work, soon spread, but the antipathy to it prevented its becoming successful in England. Queen Elizabeth regarded with contempt a man's invention of a mechanical weaver of stockings, and the Rev. William Lee's petition to her Majesty for Royal patronage passed unnoticed. From James I., Lee gained as little encouragement. He accordingly went to France, Henry IV. and his minister Sully warmly espoused his cause, and matters went prosperously with Lee until his death. It might from this be supposed that France remained in solitary possession of this valuable invention, but Mr. Felkin tells us that Mr. James Lee, son of Rev. William Lee, soon after his father's death, determined to transplant the manufacture of knitted stockings by machines to England. He accordingly brought frames and experienced workmen to London, and started operations in Old-street-square. Upon this becoming known, a spirit of imitation seized different people. Stocking-knitting frames were set up in Nottingham. Venice, the old home of artistic lace-making, was almost foremost in striving to establish stocking-knitting factories, but her attempts in this direction, through lack of skilled workmen, who should replace plant as it was worn out, soon collapsed. England, however, rapidly developed the number of her stocking looms, and between 1670 and 1695, upwards of 400 such machines were exported to France, Flanders, Spain, Italy, and Sicily. The English Legislature about this time placed its veto upon such exportation. The manufacture in this country continued in great force. Charters were granted incorporating companies for the working of stocking machines, and Parliament was called upon to consider petitions from the various manufacturing centres. In 1758, Mr. Jedediah Strutt introduced a method of ribbing stockings as they were made, and the machine for so doing was called the Derby rib machine. Other modifications of the stocking machine followed. It was about this time that taste for lace ruled that meshed grounds lightly sprinkled with small ornaments should be the most fashionable laces. Hence fine meshed fabrics like net and tulle seem to have arisen. Manufacturers in London and Nottingham applied themselves to make lace net upon stocking frames, about 1770, and so far as plain nets were concerned, they were successful in producing looped net fabrics of perfect regularity. Early in the present century, Mr. Heathcoat, of Nottingham, invented a machine for making bobbin net. After him came Mr. John Leaver, whose lace-making machines and modifications and improvements of them, to which have been applied the apparatus of the celebrated Jacquard loom, are in use at the present time.

XXX. Broadly speaking, lace-making by machinery is more nearly like the pillow-lace making process than that of needle-point. The machine contrives to twist any desired threads around one another. In pillow-lace making, besides twisting, we have plaiting. This plaiting has not been reproduced by the majority of lace machines. Quite recently, however, a French machine, called the "Dentellière" has been invented to do plaiting. Time will not allow me to refer in detail to the "Dentellière," of which a description has been published in a journal, entitled *La Nature*, dated 3rd March, 1881. Whilst, as we shall see, the ordinary lace-making machine belongs to the family of weaving machines, the "Dentellière" more nearly resembles the pillow of a lace worker, with the threads arranged over the pillow. In general appearance it looks something like a large semi-circular framework of iron, with thousands of threads from the outer semi-circle converging to the centre, representing the table or pillow. Over this central table is the apparatus which holds the end threads

side by side, and which regulates the plaiting of them. The cost of producing lace in this manner is said to be greater than by hand.

XXXI. In respect now of the lace machine which is in common use, I would ask you to reflect, that the mechanism to obtain and regulate the motions of each thread is intricate, and represents the sum total of much scientific thought, and its application to guide practice over a long course of years. Of the number of threads worked by a Leaver's machine, like that described in the *Journal of the Society of Arts* (18th and 25th Sept., 1874), it may be sufficient to say that there may be some 8,880. Of course the pattern to be worked into lace governs the number of threads. To produce the pattern shown in the *Journal* above-mentioned, 48 bobbin or shuttle threads, and 100 beam or warp threads were employed for each piece of lace. Sixty pieces of lace were simultaneously wrought, and thus sixty times 148 threads were brought into operation. This gives a total of 8,880 threads. Now, each of these 8,880 threads had its own particular duty to perform, and I hope to be able to convey to you some slight notion of these duties.

XXXII. The threads in a Leaver's lace machine then, may be divided, as they are in the loom, into two sets, the one which we may call the warp or beam

FIG. 8.

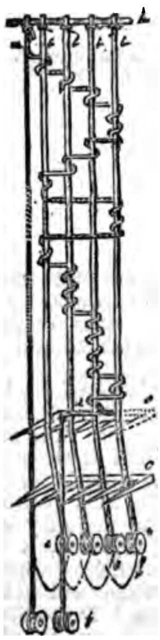


Diagram showing action of a slack weft thread in connection with taut warp threads.

FIG. 9.

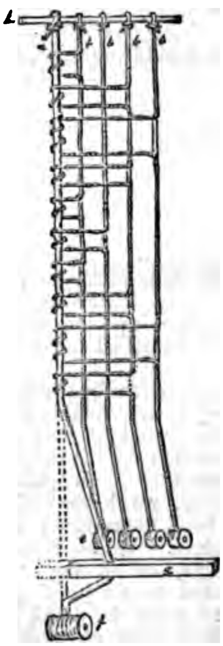


Diagram showing action of taut weft thread in connection with slack warp threads.

threads, and the other the weft or shuttle threads. The ends of both sets of threads are fixed on a cylinder or lace beam, which corresponds in its use with the first row of pins on the pillow, in pillow-lace making. The supply of the threads, warp and weft, is held by reels or bobbins. The reels of the warp threads are different from those of the weft threads. The warp thread re arranged in trays or frames beneath the above which, and between it and the cylind twisting of the weft with the warp threads place. The supplies of the weft threads ar tained in flattened reels or bobbins, which a shape as to be conveniently passed betw stretched warp threads. Each bobbin for th thread can contain about 120 yards of threa most ingenious mechanism, varying deg tension can be imparted to the warp o threads. The bobbins of the weft threads, i

FIG. 10.

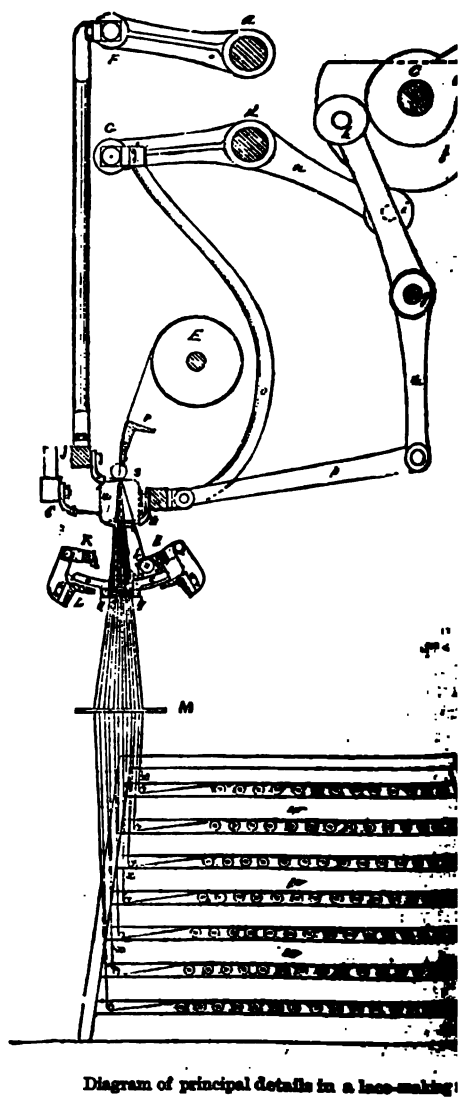


Diagram of principal details in a lace-making

pass like pendulums between the warp thre made to oscillate, and through this oscillat threads twist themselves, or become twist the warp threads. As the twistings take combs passing through both warp and weft t

the twistings. Thus the ordinary ade lace may generally be detected ressed twisted threads. In it will not y plaiting, such as we find in pillow- e made by the "Dentellière" machine. , moreover, trace in machine lace any of button-hole-stitch work, as we eedle-point work.

FIG. 11.

-made lace. Mechlin. Early 18th century.

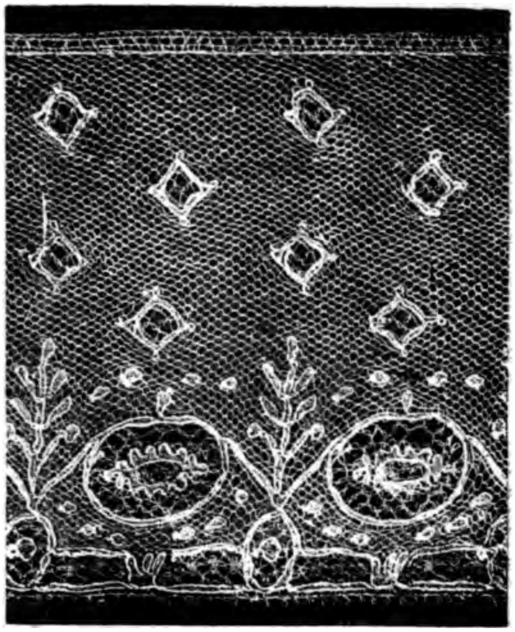
. The diagrams (Figs. 8, 9, p. 806) are o show the effects obtained by vary- sions of weft and warp threads. For f the weft threads, $b\ b\ b\ b$, in Fig. 8, nd the warp thread slack, the warp l be twisted upon the weft threads. e warp thread ($b\ b\ b\ b$) be taut, and hread (a in Fig. 9) slack, then the ds will be twisted on to the warp

FIG. 12.

ine-made imitation of Mechlin pillow lace.

t the same time we should remember wisting in both these cases arises from on of the movements of the two sets in this matter, namely, the movement to side of the beam or warp threads, and the swinging or pendulum-like oscillations of the bobbin or weft threads between the warp threads.

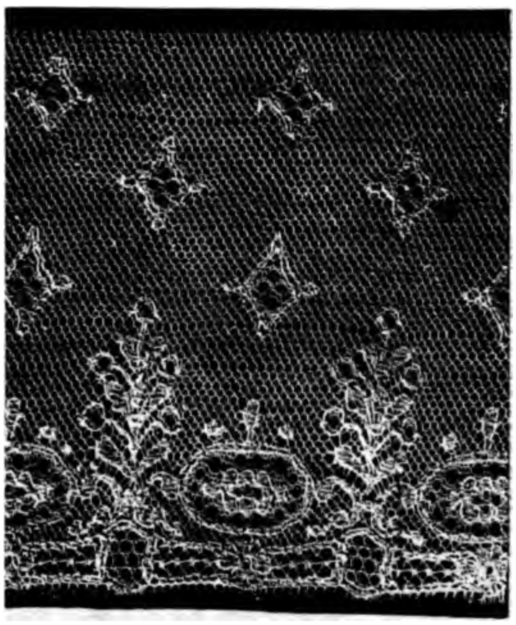
FIG. 13.



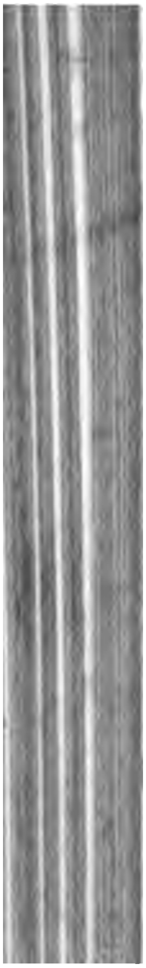
Pillow-made lace. Mechlin. 18th century.

XXXIV. The diagram (Fig. 10, p. 806) represents a section of part of a lace machine, showing E, the

FIG. 14.



Machine-made imitation of Mechlin pillow lace.



time, are most subtle. They are closely related to the Jacquard system of pierced cards. The machine lace pattern-drafter has to know more of this mathematical calculation than of drawing lines and curves. His work consists, principally, of calculating how many holes shall be punched in a card, and of settling where each hole is to be punched. Each hole regulates the movement of a thread

XXXV. We may now look at a series of specimens of machine-made laces. The first specimen (Fig. 11) is that of a Flemish pillow-lace design of the early 18th century. In it you will notice the variegated appearance of the meshes of the ground. A thread, you see, outlines the pattern, which has a fine linen appearance. Now the manufacturer (see Fig. 12) has merely attempted to reproduce the pattern. His meshes are regular. No outlining thread marks the pattern, which, instead of being filmy, like linen or cambric, is ribbed. This specimen, recently made at Calais with a Leaver machine, which is worked upon the principles I have above mentioned. The cost of this machine lace is 1s. 2d. a yard, and the value of the original is £1 5s. per yard. The next specimen (Fig. 13, p. 807) is that of a piece of Mechlin pillow lace of the late 18th century. In this you will again observe the comparatively slack manner in which the threads in the ornament are twisted and intercrossed. Here is the mechanical counterfeit of this piece (Fig. 14). The ground is similar to wire netting, while the threads to imitate those slack twistings of the original are rigid and much more regular. This, too, was made at Calais. The value per yard of the hand-made lace is £1 10s., whilst that of the machine is 2s. 9d.

XXXVI. I have now a better example of machine imitation of Mechlin lace. Here is the original lace. The appearance of the thread, forming blossoms, which seem to be a kind of sunflower, a series of petals around a dark central disc, is similar in their looseness to those in the preceding specimen. Now, in the imitation produced by the machine, we have an ingenious twisting given to the threads of the ground, whereby, in lieu of the simple twisted

lace, the *cordonnets* in which is
This specimen was made this yea
we have seen machine-made imit
class of pillow lace, *i.e.*, laces w
to the pattern. Now, howeve
imitations of Valenciennes lac
may remind ourselves of the a
made Valenciennes.

XXXVIII. Here, now, in I

FIG. 15.

Machine-made imitation of Valen

quality of machine-made Valenc
at Calais, by machines similar
Nottingham. Another specime
in design, and woven with finer
sidered to be as good as the mac

[ere we have the machine imitation (Fig. 17).]f the ribbed appearance of the close por- sharp, clear, outlining thread, and the com- wiry tautness of the ground, and of the]eries, it is a wonderful piece of imitation.

FIG. 16.

[...]t needle-point lace, "à réseau." 17th century.

How much further man's ingenuity may mechanism to produce works, delusive [...]its of handicraft, is a question not to be [...]swered, if answered at all. For anyone to follow the history of the art of lace-

FIG. 17.

[...]le imitation of Venetian needle-point lace, "à réseau."

in its literary aspect, there is plenty of to be travelled over. But as I said in an [...]cture, I do not think that this way of proceeding is as instructive as it is entertaining; and I doubt very much if any one adopting it would come

> To know the age and pedigrees,
> Of points of Flanders and Venise.

XLII. In the times of the Provence romance writers, French ladies as they worked sang "Chansons à toile." Italian poets have sung the praises of the needle, just as Taylor, our Elizabethan water poet, has lauded the "Needle's excellency." Some verses composed by Jacob Van Eyck, in the 17th century, upon the art of lace-making, and a French epic, entitled, the "Revolte des Passements," appeared about the same time. Pope, Evelyn, Swift, Congreve, and many other writers of the 18th century comment on passing fashions, and refer to laces then in vogue.

XLIII. One of the latest of English poets, who seems to have perceived that patience, perseverance, gentleness, should predominate in the character of a lacemaker, is Mr. Lewis Carroll, who has immortally associated a beaver with the art. A "beaver that paced on the deck, or would set making lace in the bow," was a member of that notable band of personages who went out hunting a snark. But when, as the poet relates,

> The Boots and the Broker were sharpening a spade,
> Each working the grindstone in turn;
> The Beaver went on making lace and displayed
> No interest in the concern.

XLIV. The Barrister, another of the hunting party,

> Tried to appeal to its pride,
> And vainly proceeded to cite—
> A number of cases, in which making laces,
> Had been proved an infringement of right;
> But the Barrister, wearied of proving in vain
> That the Beaver's lace-making was wrong—

soon fell asleep, and leaving him in that condition, I will conclude without making further quotations from this strange poem, which may not enlighten us much upon the art of lace-making. As it mellows with time, perhaps it may fall into its place as a stepping-stone in the literary history of lace-making.

XLV. It has been a privilege and pleasure to me to have been permitted to deliver this course of lectures upon the art of lace-making. In offering you my thanks for your forbearance with my shortcomings, as well as for the kind and appreciative attention you have evinced, I can but say that any dreariness which has attended my own personal efforts has, I hope, been relieved to some extent by the excellent illustrations furnished for our instruction and diversion by the authorities of the South Kensington Museum, Captain Abney, F.R.S., Sir William Drake, Mrs. Robert Goff, Mrs. Alfred Morrison, Mrs. Enthoven, Messrs. Hayward, and Messrs. Howell and James.

MISCELLANEOUS.

THE SOCIETY OF ARTS' PATENT BILL.*

By Sir Frederick J. Bramwell, F.R.S.

The Section will have observed that, in the report of the committee,† which has just been read, no opinion is

* A paper read before Section G. (Mechanical Science) of the British Association, at the York Meeting, September, 1881.

† Report of a Committee of the British Association on Patent

which patents are now granted—that of 1852. It has, from time to time, had meetings and discussions upon the subject; and seven years ago, moved thereto by the observations by certain journals believed to be prompted by persons of position, the Society thought it desirable to have the matter thoroughly well gone into. I had the honour of reading a paper on the subject in the month of November of 1874, which resulted in a protracted discussion, and, I am glad to say, in an almost unanimous expression of opinion—an opinion fortified by that of nearly every journal that noticed the discussion, and the journals that did so were very numerous—that a Patent-law was an undoubted necessity.

The various Bills introduced by the late Lord Chancellor and the late Attorney-General, and the promise made by the President of the Board of Trade of a Bill next year, are proofs of the concurrence of the Governments, both past and present, in this view. In the remarks I am about to make on the Society of Arts' Bill, I therefore intend to take it as generally conceded that there must be a Patent-law, and that the question before us is confined to the consideration of what should be the nature of that Patent-law; and I doubt not that our Chairman, in inviting the meeting to discuss this paper, will ask members to be good enough to do so in the spirit in which it is written—namely, to consider whether the Bill of the Society of Arts is one which should meet with approval or otherwise, and not to discuss the question as to whether there should, or should not be, a Patent-law at all.

At the beginning of its last Session, the Society of Arts appointed a committee, consisting of the chairman of the Society's Council (myself), Professor Abel, Mr. Alfred Carpmael, Sir Henry Cole, Captain Douglas Galton, Mr. W. H. Perkin, Dr. Siemens, and Mr. H. Trueman Wood. The committee commenced their work by drawing up a series of questions as to the mode in which a Patent-law should be framed, in regard to certain points specially enumerated; and, having done so, they asked their Secretary, Mr. H. Trueman Wood, who is helping here to-day as one of the Secretaries of Section G, to obtain and tabulate, for the information of the committee, a statement of the manner in which those various points were dealt with by the Patent-laws of other nations. Furnished with this information, the committee con-

but they determined that, before t
liament, it would be desirable th
thoroughly canvassed. They theref
intention to summon a meeting of t
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nade in a communication to the *Journal*, in answer to nquiry why liquid fuel was not employed for steam-ine purposes, and especially for steam vessels. He l, that so many attempts in this direction had been le and published, that no valid patent could be ained, and that thus, it being nobody's interest to h the invention, the invention was not pushed, was not brought into use. I am quite sure t Mr. Barff was perfectly right in his view of the e. I would repeat on this subject that which I have n quoted, because it is so very true and so very apt, expression made use of by our Chairman of to-day Dr. Siemens—namely, that for the interest of the munity, if an invention were found lying, like some phan child, in the gutter, some one should be selected, its foster father, to take up that invention.

This need of a patentee in the development of an in-ntion was the first point the committee kept before m. The second point the committee had in view, s that, so far as possible, the connection between wyers and patents should be severed. There can, I k, be little doubt that whether in regard to the inal granting of patents, or in regard to their ndment, or in regard to the trial of patent actions, wyers are the persons least adapted to perform se functions properly. No one entertains a more re respect than I do for the Bench and the r of England, and I wish, in the interests of t respect, to see them discharged of functions which certainly they ought never to have had thrust upon m.

'ortunately, having regard to the magnitude of the nsactions involved in patent matters, there is but very e patent litigation. In the year 1874, it was ascer-ed for me that there were, upon an average, only e patent actions which went so far as to be heard by ourt of First Instance in each year; and I have no son to suppose that that number has materially in-ased, if, indeed, it has increased at all. But, with pect to the few actions that are tried, a very consider-e part of the expense arises from the elaborate models ch are needed to instruct counsel upon the subject, n themselves have to inform the Court, and also jury where there is one. And further, commonly, withstanding all the expense that is gone to, and pains that are taken, the litigants have the chagrin seeing that they have not been successful in making mselves understood either by the Court or the jury, it may be, not even by their own counsel.

Having thus stated to you the history of the Society of s' Bill, and the main principles upon which it is nded, I will now briefly touch upon one or two its leading features, showing how it has been med with the view of carrying these principles into ct, referring the Section to the printed memorandum ch has been distributed amongst them for further rmation on the subject. The Patent Bill has already peared *in extenso* in the Society of Arts' *Journal* of gust 5, 1881, and a few copies of it in the Parlia-ntary form are here, for the use of those who wish to tain the exact wording of any particular section.

t will be seen by the memorandum, the first proposi-n is, that there should be appointed, in lieu of the sent Commissioners, who are all legal officials, a y of three Commissioners, one of whom should be well uainted with Engineering, one with Chemistry, and e with Law. Power is given to the Commissioners, h the approval of the Treasury, to appoint the ssful staff. It is intended that these Commissioners uld be the persons to grant patents, after a slight mination by examiners, not as to novelty, not as to lity, not as to sufficiency of invention, but simply to ure that the necessary forms are complied with, and t a sufficient description is given.

The Commissioners, also, are those who would hear positions, which it is proposed to confine to per-s who allege that the invention has been fraudulently obtained from them. They are also those who would consider as to Amendments, and as to Prolongations—and it is intended that both Amendments and Prolongations should be made more easy than they are at present. And, finally, it is the Commissioners who would hear patent causes. This remitting to the Commissioners the trial of patent causes is, probably, the most thorough change made by the Bill, but the committee consider they are not without a precedent in the matter. It is now many years ago since the Railway Commissioners were appointed for the express purpose of determining questions between railway and canal companies and the public, and it is quite certain, that if it were found expedient to appoint a special body for the purpose of determining questions which involve no details of machinery, which demand no knowledge of chemistry, but which are simply questions of contract, or of the application of rates and charges of various amounts to various circumstances, still more is it needed that there should be a special tribunal for the trial of patent causes, involving, as they commonly do, matters with which no existing tribunal is competent to deal.

Among the other provisions it will be found, on examining the Bill, that the procedure has been modified, with the object of helping the patentee to obtain his patent more easily than at present, and more cheaply, and also with the object of rendering the patent more secure when he has once obtained it. That an attempt has been made to settle the vexed question of subject matter, by substituting a fresh definition in place of the practically obsolete one contained in the Statute of Monopolies—"A New Manufacture within this Realm."

With respect to pleas in patent actions at the present time, the defendant, even if he has undoubtedly pirated and used, without the patentee's consent, a valuable invention given to the public by the patentee, is enabled successfully to resist an action brought against him, if he can prove that some of the matter comprised within that patent, matter which he has not infringed, is not new, although the particular matter which he has infringed is new. He is also enabled to succeed in his defence, if he can show that these other matters which he has not infringed are, inadequately specified. He is also enabled to succeed in his defence, if he can show from a consideration of the Provisional Specification, that the matters claimed in the final specification were not those for which, strictly and legally speaking, the patent was granted It is true that, if the defendant succeeds on any of these points, the patentee can commonly cure the defect in his specification by a disclaimer; yet even that is not secured to the patentee as matter of right, but as a matter of grace and favour, and is, if granted, too commonly coupled with conditions. And with regard to this question of want of novelty, it is sufficient for the defendant's purposes if a single publication—say in the British Museum—of 50 or 100 years old, not looked at once in ten years probably, and utterly unknown to those engaged in the manufacture to which the patent relates, can be raked up, and can be shown to contain, it may be, not the invention as described in the specification, but something which may be said to come within the general terms of the claim. The committee who framed the Society of Arts' Bill, as you will have gathered from what has already been said, are of opinion that it is contrary to the interests of the public that a patentee should be deprived of his invention by what, after all, are technicalities. Further, it is a very common thing for a patentee to obtain Provisional Protection, and having done so, either through being too much occupied with other matters, or through being incompetent to develop his own idea, to abandon the further proceeding with the patent, and to allow his Provisional Protection to lapse, and thereupon the Provisional Specification is made public. I believe I am right in saying that something like 30 to 40 per

for the details. I did not deem it worth my while to proceed under these circumstances, and it is certainly not worth the while of any manufacture of chain cables to carry out the idea which was in my mind, and in that Provisional Specification. It is on such grounds as these, that the committee who have prepared the Patent Bill of the Society of Arts, propose the Provisional Specification should be a merely temporary document, and that it should never be made public so that whether a patent be granted, or whether the Provisional Protection be suffered to lapse, the document should be destroyed. Similarly, it appeared to the committee that it was inexpedient a patent should be rendered invalid by any dormant publication, such as a book in the British Museum, and therefore they proposed, that unless an invention can be proved to have been in use within thirty years, no mere publication, unaccompanied by use, should be considered an anticipation of a patent. With respect to the term of a patent, it will be seen that the committee suggest the American term of 17 years, coupled with the power of Prolongation for a further 11 years. The term of 17 years has been taken, coupled with this power, in preference to the term of 21 years proposed in the Government Bill of 1879, unaccompanied by Prolongation, as the committee deemed that 17 years, if the patent were successful, would afford the patentee sufficient remuneration, and also, that having once established a body competent to deal with patent matters, there would no longer remain the difficulty of obtaining satisfactory decisions in cases of Prolongation. The scale of fees proposed, in order to obtain a patent, is that of the Government Bill of 1879, and, as regards the subsequent payments, is practically the same as was proposed in that Bill.

In this, the most recent Government Bill, provisions were made for the cessation of the patent if the invention were not put to work within a given time, and, in addition, provisions were made that compulsory licenses should be granted by the patentee. The committee of the British Association which considered the Government Bill of 1879, strongly urged the undesirability of the first of these provisions, and pointed out that where a patentee was bound to grant a license, there was no reason why he should be deprived of his patent, if he himself failed to put it to work, and they gave instances in which it would be extremely difficult for the patentee to obtain

Jeremiah Head, Dr. Siemens, Mr.
H. Trueman Wood, and others too

Sir Antonio Brady said—I should
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ing system. Moreover, there are

y of the man who owns it. The law cannot give absolute power over it, because the Courts must many questions of patent rights afterwards; but : it is a marvellous improvement that this Bill ve inventors generally, because it will be a very thing for any person to contest a patent which en granted under the provisions of this Bill; us now I am not wrong in saying that Sir Henry ner, who has enriched the whole world by his in- ns, has been put to enormous expense to defend f against certain patents which were lying nt, and has been obliged to compensate the of them rather than go to law in such cases. I there are several other instances in which a small t has cost £50,000 or £60,000 to defend it, which t be the case under such a Bill as this. Further, in esent day, the inventive genius of our people should couraged in every possible way. This is a small ry. We cannot compete with larger countries, we utilise the brains of our people, and give them sistance of the Patent-laws, which will encourage inventive genius. You spoke, sir, just now, about iemens, whom I am very glad to see in the room. eve that I am right in saying that he could not get tent in Germany, and we have had the advantage splendid genius and of his inventions, which we l not have possessed but for the Patent-law. I e there are other instances—not, perhaps, of such tent as this—and therefore I say that it is of the st possible moment to this commercial country to rage the inventive genius of our people to the st possible extent; and I don't think there can be bjection in the mind of any sane man to extend nt over a period of 17 years, as this Bill proposes. uld have preferred 20 years, as in recent Bills, he Bill provides a power of extending the term certain circumstances.

. **Jeremiah Head**.—As one of the numerous class of tees, I have asked for a moment or two to pay my sum of thanks to Sir Frederick Bramwell for g brought this question before us. I can se all he says of the way that the law, as it now s, seems to punish the patentee as much as ever it A man who has an invention has no way of ning the information necessary, except by appeal- to a patent agent, and although there is no n to doubt that patent agents, as a rule, are honest, is clear that their interest is rather in favour of aging a man to go on. The patentee goes on pends, before he can complete his patent, some- like £40, and in three years time he has to spend er £50. That is a very large sum of money, et it does not at all include what he has pend in experiments. It is proved, by the number of patents that are dropped at the us stages, that it would be better if a ity of them had never been taken out. They been found either not to be new, or the inventors not ready to incur lightly the great expense of ng them to perfection, finding after two or three that they had better drop them, after having lost f money, of time, and of thought, and that, in hey were not the men to bring out the thing at o doubt, according to our present law, the Patent- has got the man's fees, and does not seem to care, at man is a disappointed man, and, therefore, I that it is a disadvantage that he should have d his time and his money over an invention had better have been brought out, if at all, me one else. I did not quite gather from rederick Bramwell whether he proposed in this at there should be any way or any body to whom entor, getting an idea, could write, on paying a fee, and have his ideas submitted to some sort of minary test; whether on payment of such a fee he be referred to this, that, or the other patent previously taken out, or some suggestion made to him, which, would, in many cases, discourage him from going on. I think that is very much wanted indeed, and it is only to be obtained now by appealing to patent agents, who do not always advise disinterestedly.

Mr. Barff.—I just wish to ask one question, if there is any special reason for making the payment at the end of the fourth year so great as £10. We know that there are a great many patents that in four years cannot have paid themselves, and this tax of £10 seems rather high. The great advantage of an improved Patent-law would be that it would give men a greater interest in their work, as they would have some encouragement to study what they were doing every day, with a view to its improvement, and get a patent for the improvement. But I merely wish to ask whether this payment of £10 at the end of the fourth year is not higher than it need be.

Sir Frederick Bramwell.—The payment at the end of the fourth year instead of £10 is £30.

Dr. Siemens, F.R.S.—If anything were needed to show the difficulty surrounding the framing of a good and just Patent-law, the observations that have fallen from the last two speakers would furnish incidental proof. Mr. Head, who is so well known for his mechanical talent, suggests that the obtaining of a patent should be made very difficult—that the patentee should not only prove that he had novelty, but that he had usefulness. I am afraid that, if that suggestion were adopted, many valuable patents would fall to the ground or be stillborn. It is the very essence of an invention that it cannot be worked in its first conception, because an invention is not a mere idea. An idea may strike the mind at one instant, but an invention is necessarily the result of labour—mental and physical—and of expenditure, and there is hardly an invention ever brought out that in its first stage would have stood such a test. I cannot agree with Mr. Head in supposing that all those inventions that have not taken immediate effect, and enriched the patentees, are so much loss to the country. On the contrary, although the inventor is to be felt for who has not reaped any benefit from his invention and for his labour, yet the public at large profits by it, because it may form the stepping-stone for somebody else to carry the idea to its practical point. The Patent-law must not be based upon the idea that all difficulties will be done away with, that all men are to be made happy, and that there is to be no legal contention of any sort. That would be a chimera such as could not reasonably be expected. If it is difficult to establish a title to landed property, surely it may be reasonably supposed that it is as difficult to establish a title to the product of the mind; and all we can do is to render the administration of that property as simple and as just all round as it possibly can be made, humanly speaking. The Patent-law worked out nominally by the Society of Arts, but in reality by my excellent friend, Sir Frederick Bramwell, is, I think, the best considered, and, perhaps, the most perfect attempt at a just and equitable law on the subject; and I, as one of the committee, can only hope that it will find favour in this Section in order that it may be strengthened by the weight of the British Association, and that the Legislature of the country may take a similar view. It is idle to discuss partial questions connected with such a law, as, for instance, that the fees to be paid by a patentee should be a great deal less. It is now proposed also to extend the operation of the patent over 21 years instead of 17. You may depend upon this that all these questions have been very carefully considered by the committee, and also tested by legal opinion, and that this Bill is the result of the careful and long meditations on the subject by Sir Frederick Bramwell, and of the discussions that took place in the committee, of

Mr. H. Trueman Wood—I should like to be allowed to answer an objection, which has not been brought forward here, but which has appeared in one or two very influential journals, about the Society of Arts' Patent Bill. It has been said that the provision in it for examination would give the Commissioners the power of stopping invention, by refusing to allow an applicant to take out a patent. Now, as a matter of fact, the power given by this Bill is considerably less than that which is at present possessed by the law officers of the Crown; and I do not think it has been asserted that the present Patent-law, whatever else may be its defects, gives the power to stop invention. The very slight examination permitted under this Bill, is not an examination into merit or into novelty; it is merely a sufficient examination to enable the office to say that the matter in respect of which the application is made is really connected with Science, or Manufactures, or Commerce, and ought to be protected by a patent. My only reason for making this remark now is, that this objection has been urged very strongly, and I should be glad to have it put on record that no such power exists in the Bill. Indeed any person who reads it carefully will not be able to find any such power in it.

Mr. W. Hancock said that 20 years ago, at a meeting of the British Association at Manchester, he was on a committee that then sat on the Patent-laws. They had several very long discussions, especially as to whether there should be a preliminary examination. The broad conclusion arrived at was that it was desirable that there should be examinations as to novelty, but no examination as to utility. There was one thing that rather struck him, and that was as to the destruction of the provisional specification. If there was to be this destruction there should be the most stringent safeguards that the final specification does not trangress, or go beyond in any way the grounds of the invention at the time it was granted.

Sir Frederick Bramwell—Clearly it would be impossible to propose the destruction of the provisional specification, in those cases where the patent was granted, unless there were a competent examination to see that the completed specification did not go beyond that which was a fair development.

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sional specification should be destroyed as being, the public, a bar to further improvement. But the ion whether, in those cases where the patent is sed, the provisional specification should be destroyed, a which will be well considered by the Society the Council finally adopt the Bill. With respect question of fees, if they are made too low, I am there might be such a mass of patents granted they would be a nuisance; and I cannot help king that the opponents of a Patent-law altogether ld chuckle at the notion of, say, a shilling fee or ning of that kind. I am aware, on the other d, that it may be said it is a very hard thing that, se a man of great ability and ingenuity does not e £10, and a man of less ability and ingenuity , the former should be debarred from the protection the latter can get. I am one of those who desire earnestly that all those who have any good in should be able to bring it out, and reap advan- for themselves, while giving the benefit of it to s, but there are a variety of things we should all people to have if it were possible, but, pily, it is one of the pains of poverty that they t have them, and, therefore, those who frame a of this kind have to hold the balance between desire of affording cheap patents and their fear if patents be made too cheap, they will be ily taken out, and will become so obnoxious as d to the abolition of patents altogether. Let me his question of the necessity, in the interest of the enance of patents, of something more than al fees, by asking whether any one present would st that patents could survive if they were granted itously. I am sure you feel that, if you issued itous patents, they would be intolerable. What e should be it is most difficult to determine. Far from saying that the Society of Arts have adopted ight scale. I feel that I shall not be very wrong I state that the committee were glad to base them e scale in the Bill of 1879, which scale seemed to with very general approval, and they adopted it, such modifications as were needed to vary the s of subsequent payments in a Bill that provides for ers duration of a patent in lieu of the 21 years osed in the 1879 Bill. With respect to Mr. 's suggestion, it seems, as far as I could follow him, he thought there should be a sort of friendly Board hich an intending patentee could go and say in dence, "I have invented this; do you think it is y to answer?" Now it does appear to me, with spect, that that is a thing that could not possibly t. I feel certain that that kind of paternal legis- n would not do. Imagine a Board to which an nding litigant, in a civil action, could go say, "I am thinking of bringing an action respect to that right of way over my field. you think I am likely to succeed?" I am glad to that, except on the subject of the scale of fees, on ch I have already fully remarked, the Bill has the rty approval of Sir Antonio Brady. I believe I have , although in a very cursory manner, answered the ous suggestions that have been made. With respect hat provision of our Bill for removing patents from domain of the lawyer, I am glad to say that it meets, ently, with the approval of those now in power. y so because the announcement made to us is, not the Government Bill of 1882 is to emanate from ord Chancellor or from the Attorney-General, but it is to proceed from the Board of Trade. We written to the principal persons interested in matters, and have sent copies of the Bill to them, ng at the same time we hope that between now the meeting of Parliament the Bill may receive general approval that the Government may see way to incorporate its provisions in the measures propose to bring forward. With these obser- ons, I conclude what I have to say, except this, that I have to thank you most warmly for the close attention you have paid to a subject which, although it is done, no oubt, of great importance, is, on the other hand, an extremely dry one. The question of the Patent-law is one I have studied for many years, and I, no doubt, have worked hard in the preparation of the Society of Arts' Patent Bill; but Dr. Siemens was pleased to give me far more credit than is my due, and omitted to tell you the share he and others have had in the work. He did not tell you that he was the chairman of the successive committees of the British Association that have sat on this very matter. It was the fact of finding myself in the position of chairman of the Society of Arts that led me to suggest that the course they have followed should be pursued by that Society, while we had the advantage of the assistance of many gentlemen who are members of the committee of the British Association. I trust the Committee of Recommendations will agree to the demand made, that the Patents Committee should be continued, and you may reply upon it that when the Government Bill is brought forward it will be thoroughly scrutinised, and we will do our best to make such alterations in it as will bring it towards the measure prepared with so much labour by the Society of Arts.

Mr. T. Hawkesley—You have all listened with much attention to the eloquent address of my friend Sir Frederick Bramwell. The subject is one in which I take a great interest, but it is far too complex for me to express my opinion upon it at the present period of the day. But I am sure you will all agree that Sir Frederick Bramwell is entitled to an enthusiastic vote of thanks. I therefore beg to propose your thanks to him from the chair.

Sir Frederick Bramwell—I am very much obliged to you for your vote of thanks. Let me say, in conclusion, that if we obtain a really good Patent Act I shall be more than rewarded for the continued pains I have bestowed on the question—the best reward I can get is to see a good Bill embodying the bulk of these clauses.

FREDERIC SAUVAGE.

The *Times* gives a sketch of the life of Frederic Sauvage, to whom the people of Boulogne having just erected a statue, as the inventor of the screw propeller. His claim to this honour rests on the fact that in 1832, hearing that the French Government proposed to build a number of paddle steamers, he was led to devise a better means of propulsion, and eventually he constructed a screw. Early in that year Sauvage exhibited to the Boulogne authorities his new invention, which was highly approved. As he was anxious to bring it under the notice of Government, he gave up his Boulogne residence and left for Paris, where he took out a patent for 15 years. The screw was acknowledged to have its advantages with small boats, but the Commissioners who sat by order of the Minister of Marine to report on it concluded that it would be of no use for large vessels. The English Government in 1835, it is stated by the *Times*, offered him a sum for the invention, on the condition that it was to become the exclusive property of England, but the inventor, who was at that time stricken down by poverty, would not consent. It is further said that Sir Francis Pettit Smith derived his first idea of a screw from a visit to Sauvage's workshop. In 1841, Sauvage made an agreement with a shipbuilder and an engineer for the construction of a steamboat, to which the screw was to be fitted, he giving the plans, while they carried them out, and at their own expense, but the agreement, owing to a technical misunderstanding, was badly worded. The boat was built and fitted, but not as Sauvage wished, and the two others took all the credit. The unlucky inventor, forsaken by all, after many years of toil, was in the year

It is probable that Sauvage's claims will receive but little attention outside his own country. In England, it will be remembered, in 1770, James Watt, writing to Dr. Small, proposed to use one of his steam-engines to drive a screw for the propulsion of a ship. In 1776, the American, Bushnell, described a submarine boat, propelled by a screw. Trevithick patented a screw propeller in 1816: and before him, in 1800, Edward Shorter patented a propeller, which was afterwards, in 1802, tried on H.M.'s ships *Dragon* and *Superb*. In America, Stevens, in 1804, tried to propel a boat by a screw. In 1816, Millington described a screw with a very ingenious steering arrangement connected to it, and this was apparently the first of a great number of attempts which have been made in that direction; all, as yet, unsuccessful. From this date till the date of F. Pettit Smith's invention (1836), the records of the Patent-office show that many minds were working in the same direction. The point of Smith's invention was the placing of the screw propeller in the dead wood of the vessel, nor has it ever been claimed for Smith that he was the inventor of the screw propeller, though he was, there seems little doubt, the one to bring it into actual use. There seems little question that Sauvage did nothing more than was done by very many others—by Watt, Trevithick, and the rest—conceived a most valuable idea, but never carried it beyond the stage of a model.

THE MINERAL RESOURCES OF TURKEY.

Consul Wrench in a recent report states, with reference to the resources of Turkey, that although the country teems with mineral wealth of various kinds, they are left almost undeveloped, except in the case of some products which are elsewhere rare, but found abundantly and of great richness and purity in the Levant. The meerschaum from Eskishehir, in the district of Kutayah, still continues to hold its supremacy; in recent times both emery stone and chromate of iron have been exported from Turkey in increasing quantities, and now the markets of the world are mainly dependent on this country for supplies of these minerals. Manganese ores, crystalline pyrolusite of remarkable richness and purity, have also been to some extent exported of late years to Europe. Boracite

ago, in the eight acres of ground
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plane for covering the ore to the base
water power is available for crushi

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ions for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

EDINGS OF THE SOCIETY.

CANTOR LECTURES.

COLOUR BLINDNESS.

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—Delivered Monday, May 16, 1881.

. Nature of colour vision generally. ght—its composition. The prismatic Invisibility of certain elements of the to the colour-blind. Appearance of the ons of the remaining elements. Varieties itions of the resulting colour blindness.

ng been known to those engaged in the natural philosophy, and, to some extent, general public, that certain persons are d as not to possess the same complete-our sensation as the great bulk of the . Until lately, however, defective n was considered to be a somewhat rare a matter for philosophical curiosity t of only slight practical importance. reserved for our own time to discover blindness affects rather more than four the whole male population of civilised and that it affects certain classes in a r proportion; while, at the same time, have sprung up, and have attained to e development, in which the employment lind persons may easily occasion, and n has occasioned, great calamities. The ng of railway traffic and of steam is almost entirely dependent upon the ur signals; and for these signals the efly employed are red and green, the bout which the colour-blind fall into rror and confusion. There is a general mong practical men that these two not be replaced for signalling purposes ers; and hence it has become impera-ssary to exclude the colour-blind from s in which the lives of large numbers of y be offered up as sacrifices to their cy. There are, in Great Britain, about employed as engine drivers; and there mong these, about 400 who are colour-whose work is a source of never ending o themselves and others.

intention, in this preliminary lecture, iefly of the nature of colour blindness; is purpose, it will be necessary to pave the way by speaking of the nature of colour vision. The many among my audience who are fully acquainted with the existing state of knowledge on this subject must be asked to pardon the introduction of elementary matter, which seems necessary to order to give any approach to completeness to my discourse.

The quality to which we give the name of colour depends entirely upon the kind of light which is transmitted through a coloured medium, or reflected from the surface of a coloured opaque substance. In order to make this clear, we must remember that we see surrounding objects only by virtue of the light proceeding from them, and that this light is derived, either directly or indirectly, from the sun. If we carry the matter a step farther, we find that what we describe as light is merely an impression made upon our eyes by vibration or wave movement; and that this wave movement occurs in an infinitely subtle fluid medium, called luminiferous ether, which pervades space, and fills the intervals between the molecules of all transparent substances. Just as water is a more mobile and subtle fluid than mercury, or air than water, or hydrogen gas than air, so this hypothetical ether is more subtle than hydrogen; and it is indeed so subtle that it transcends our knowledge entirely, except by its effects in the propagation of the waves of light. A study of the phenomena of light shows these phenomena to be of a kind which only wave movement can explain, and which bear a striking analogy to those produced by the visible waves of water, or by the invisible waves of air which we recognise under the name of sound. I must therefore ask you to picture to yourselves the whole universe as filled and pervaded with this infinitely subtle and mobile luminiferous or light-carrying ether; and to realise that what we describe as light is nothing more than a vibration or wave movement in this ether, just as sound is nothing more than a comparatively coarse vibration or wave movement in air. Between the wave movements of sound and those of light there are differences as well as resemblances, but the former do not at present fall within the scope of our notice.

In the propagation of wave movement, it must be remembered, the particles which form the wave do not themselves travel, but only oscillate. If we stand by the smooth surface of a pool of water, on which some corks are floating, and if we throw a stone into the middle of the pool, we shall initiate a violent wave movement, which will be quickly propagated in all directions from the centre of disturbance to the extreme margin of the water. The surface of this water will be thrown into alternate elevations and depressions, and these elevations and depressions will travel to the shore; but the water in which they occur does not travel, but only moves up and down. If we watch the floating corks, we shall see the whole mechanism of the process. The corks will bob up and down on the successive waves, but will retain their original places on the pool; and, when the wave movement subsides, the corks will be left where they were at first. If the propagation of the waves is checked by some obstacle, as by a wall bounding the pool, they will be turned back, and the secondary or reflected waves thus formed will intermingle with those which are still advancing from the centre,

certain definite manner, dependent upon the nature and position of its surface. The human eye contains a mechanism by means of which the light waves which enter it are re-arranged upon the nerve tissue subservient to vision, in a reduced reproduction of the pattern in which they left the obstacle, and so we are said to see the objects around us. What is meant by seeing, is that the vibratory movement of the luminiferous ether, being first rearranged within the eye according to the way in which it was reflected from the visible object, produces corresponding molecular movement in the nerve tissue, and this movement becomes the subject of consciousness. All vision depends upon the nerve tissue being made to vibrate in unison with the vibrations which constitute light.

The light which we receive from the sun is white or colourless; and hence, if this light were pure and unmixed, so that it was reflected from all surfaces precisely as it fell upon them, subject only to more or less diminution of quantity from absorption or in transmission, the effect would be that the pattern or picture formed within the eye would exhibit differences of light and shade alone. The visible world would be deprived of colour, and would be reduced to the level of a "black and white" exhibition.

In reality, however, the solar light is a mixture produced by the blending together of three different rates and magnitudes of vibration. The waves of largest size and of the slowest oscillation, when we receive them alone, produce a nerve movement which excites the sensation that we call red. The waves of intermediate size and quickness, when we receive them alone, produce a nerve movement which excites the sensation that we call green, and the smallest and most rapid waves produce a nerve movement which excites the sensation that we call violet. For the foundation of this discovery the world was indebted to the genius of Newton.

Material substances may be roughly divided, in

The light waves no longer strike the glass fairly and fully, at right angle but obliquely, so that one end of ea the surface before the other. The this is that one end is more retarded and that the course of the wave is This is called refraction, and you w whereas the plate of glass held leaves the position of the bright lin unchanged, the plate held obliq beam of light, and alters the positi

Now, although all light is thus b when it falls obliquely upon the su parent medium, the degree of depends very much upon the magn of the wave movement; being mu small and rapid waves than for ones. Hence, by means of a prism for producing a high degree of ref able to split up the solar light into parts, and to exhibit them separate will now rekindle the lamp, and wil ful prism in the track of the beam, what is called the prismatic spectru immortal discovery of Newton.

The first thing you will observe the prismatic spectrum is that, alt as a whole is bent out of its course, produce upon your eyes the impr are those which are bent the mos produce the impression of green a degree, and those which produce th red are bent least of all. This is the difference of the amount of r is incidental to the difference of w explains the principle upon whic up of the solar light into its co depends.

The next thing to be observed is trum is not limited to the three named, red, green, and violet, but others also. We may now aban light, and turn to a pictorial repre

first arrived at upon the point. It was reserved for the late Professor Clerk Maxwell to clear up all doubt upon this subject, and to prove beyond question that the true primaries are red, green, and violet, or, as he called it, blue. Orange is a mixture of red and green with the red in excess; yellow a similar mixture with the green in excess; while blue and indigo are mixtures of green with violet. The difficulties which stood in the way of an accurate determination of the primaries were largely due to an element of confusion introduced by the use of pigments for the purposes of experiment. People who were accustomed to mix blue paint and yellow paint to produce green, found it difficult to believe that the green of the spectrum was anything more than a mixture of the blue and yellow by which it was bordered; but as Mr. Ladd will show you, an admixture of the blue and yellow of the spectrum does not produce green, but white. The blue light being a compound of green with violet, and the yellow light being a compound of green with red, the two together afford the three primaries, which combine to form white. In the paints, on the contrary, the material which appears blue absorbs and quenches red—while the material which appears yellow absorbs and quenches violet; so that only the green, which is common to both, is reflected unchanged to the spectator from the mixture.

We have now arrived at the point that sunlight consists of three colours, or, more properly, of ether in three different states of vibration; and my next proposition is that nearly all substances have differences of behaviour in relation to these three states respectively. Speaking of light generally, we may say that it is affected by matter in three chief ways. It is either reflected from surfaces, or transmitted through substances, or absorbed and quenched within their mass, and it undergoes all these operations in some degree in every case. To say that a surface is perfectly white in sunlight is a way of stating that it not only reflects back to the spectator a large amount of the light which it receives, but that it also reflects it in unchanged proportion of its constituent parts, turning back long, short, and medium waves with absolute impartiality. To say that a surface is black in sunlight is a way of stating not only that it absorbs nearly all the light it receives, and quenches this light by arresting the wave movement within its mass, but that it also absorbs and quenches impartially with no distinction between wave lengths. To say that a surface is red, is to say that it absorbs and quenches the green and violet rays, but that it permits the red to be reflected, and the same applies to the other primary colours also. A green surface is one which reflects green rays while it absorbs and quenches red and violet, and a violet surface is one which reflects violet, but quenches red and green. In order to illustrate this, Mr. Ladd will once more throw the prismatic spectrum on the screen. A piece of white paper, wherever we hold it, reflects the colour which falls upon it, and appears red, yellow, green, or blue, according to its position. A piece of black paper, wherever we hold it absorbs the light which falls upon it, and appears black without reference to its position. A piece of red ribbon, held in the red end of the spectrum, receives only light which it is capable of reflecting, and shows its proper colour with unusual brilliancy; but, if we carry it into the green portion, it receives nothing which it does not absorb, and it appears entirely black. A piece of green ribbon, on the other hand, is vivid in the green portion, and appears black in the red.

We thus arrive at the fact, that the apparent colour of any object is due to the selective power which it possesses of quenching certain elements of white light, while it reflects the rest, and the seeming difficulty of reconciling the infinite variety of colour with the fewness of the three elementary or primary colours will disappear as soon as we consider how these three primaries are produced. Very large numbers can hardly be realised by the mind, and there would be no advantage in stating the figures which I am about to give with entire exactness, even if that were attainable. I will be content to say that the lengths of the waves of light are such that about 35,000 waves of red, about 50,000 waves of green, and about 60,000 waves of violet, would be comprised within the length of a single inch. If we take the medium, the 50,000 waves in an inch as the basis of a farther calculation, and consider that the speed of the propagation of light is about 190,000 miles in a second of time, we may find by simple multiplication that the actual number of the waves which produce the sensation of light amounts to hundreds of billions in a second. We must, therefore, regard each primary colour as being composed of an infinite number of units, and the number of possible combinations from billions of units of red, billions of units of green and billions of units of violet, if not absolutely incalculable, is at least inexhaustable. It must be remembered, moreover, that these combinations do not possess any obvious character to declare them for the mixtures which they are. The simple mixtures, such as orange, yellow, blue, and indigo, were long believed to be themselves primaries, and the effect of a mixture is not a question of the mere addition or subtraction of a tint, but is rather a modification of the whole character of the aggregate resulting wave movement by the various clashings, blendings, and interferences of one series of waves with the rest. The spectator who looks down from a favourable position upon the "multitudinous laughter" of the ocean, and who sees upon its surface a movement which is never the same, may realise from that magnified representation something of the possible diversity which the endless combinations of the waves of colour may be equally capable of producing.

Excepting in the prismatic spectrum, carefully obtained under specified conditions, we never see a primary colour in a state of purity. The colours of all natural objects are mixtures; and even those which appear identical with the pure red or the pure green may be easily shown to be mixtures by careful experiment. If we take such an object as a geranium petal, which we should call almost pure red, and look at it by sunlight, a portion of that sunlight is reflected back to us absolutely from the surface of the petal, and that portion, which has not at all penetrated into the tissue, is reflected unchanged, or as white light. The light

green, we must not be supposed to imply, otherwise than when speaking roughly and inexactly, that it transmits the red rays or the green rays and quenches all others. What it does, as a matter of fact, is to transmit a mixture, in which red or green is predominant, but from which other colours are not excluded. Mr. Ladd will throw the electric beam once more upon the screen, and will then place before the lantern a piece of red glass, such as is used for the danger signals on railways. You see the white spot is transformed into what you would call a red one; and you would be inclined to say that the light falling upon the screen was red light only, the glass having intercepted all the rest. We will test this by the interposition of a prism, which breaks up the so-called red light into its component parts, and shows us that it contains also a certain quantity of violet. We will now repeat the experiment with the green glass used for railway lanterns; and here again we shall find that the green light, as we should at first be inclined to call it, has by no means been deprived of all admixture with other colours. In other words, the colours which we call, in common parlance, red or green, are not accurately described by this form of expression. In reality, they are mixtures, in the composition of which red or green is no more than the predominant ingredient. To this element in the question I am anxious especially to direct attention, because we shall have to return to it hereafter.

If we pass on now to the effects of these colours upon the sense of sight, we shall find that the healthy human eye, as it is organised in the great majority of people, not only recognises the quantitative arrangement of the light in the pictures which are formed upon its retina or nervous screen, but also recognises differences in the rapidity and amplitude of the wave movement of which this light is composed; seeing, in other words, not only form and light and shade, but colour also. There are others, very few in number

to him.

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subservient to the sense of visic
surface formed of the terminatio
of two obviously different kinds,
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are most abundant in the centr
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comparatively defective. It wa
Dr. Young, whose conjecture,
modified form, has been adopte
that the cones may be of three d
of which responds to sensations
to sensations of green, a third
violet; and that, in the persons
one colour, one of these varieties
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no farther than to repeat F
formula, "it may be so." Anoth
the facts is to remind you that
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municated to the air by other
tuned in a similar manner; whil
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would at once respond to vibrati
fitted to excite them. Mr. Ladd
of tuning forks with which to ex
and you will observe that, when
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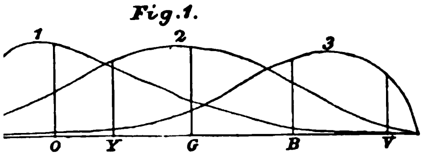
next alter the pitch of one of th
one of its prongs with a lump o
will observe that, in this stat
affected by its fellow; while, if
were to be loaded precisely to th
the first, its power to produce
first would be restored. Now
deal of analogy between the
and the waves of sound; and

he facts; and these, as we shall see pre- are very curious and interesting.

iave just stated, Professor Helmholtz, in unt of the theory of colour sensation pro- l by Young, assumes that there are in mal eye three kinds of nerve fibres, mulation of fibres of the first kind pro- ie sensation of red, that stimulation of the kind produces the sensation of green, and mulation of the third kind produces the n of violet. He assumes also that neous or monochromatic light excites iree kinds of fibres in varying degrees ig to the wave lengths. The red-perceptive rill be most stimulated by light of the wave-length, and the violet-perceptive by the smallest wave-length. It must also ned, however, that each colour excites all nds of fibres, although it excites one kind iore strongly than the others. Helmholtz es this by the diagram shown in Fig. 1,

Fig. 1.



ch the colours of the spectrum, omitting ligo, are arranged in a row from red to ind in which the three curves represent the y of stimulation of the three kinds of The curve marked 1 represents the stimu- f the red-perceptive fibres, the curve marked ents the stimulation of the green-perceptive, curve marked 3 represents the stimulation violet-perceptive fibres.

le *red* strongly stimulates the red-per- less the other two: sensation, *red.*

le *yellow* stimulates moderately the red and perceptive, feebly the violet: sensation,

le *green* stimulates strongly the green-per- much less the other two: sensation, *green.*

le *blue* stimulates moderately the green and erceptive fibres, feebly the red: sensation,

le *violet* stimulates strongly the violet-per- feebly the other fibres: sensation, *violet.*

lly strong stimulation of all the fibres gives iation of white or whitish colours.

essor Helmholtz is fully aware of the ies which impede the acceptance of Young's esis of there being three kinds of fibres, suggests, as a possible modification, that eparate functions may be discharged by re. Whether this be so, it is not at pre- her possible or very important to ascertain; her of the foregoing hypotheses, or the esis of variations of tension rendering the ncapable of responding to certain rates ation, will serve almost equally well to the phenomena which have been observed. peaking of these phenomena, Professor en has made use of Helmholtz's diagram, modified it in such a manner as to exhibit ets of colour blindness. I could not pre- sent the whole question to you in any other way so well as by quoting his words, which I take from the American translation published by the Smithsonian Institution. He says:—

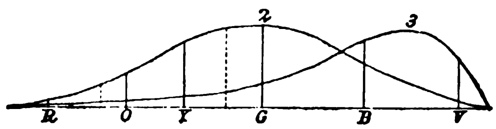
"To explain the abnormal sense of colours by the theory of the normal, we can, in advance, suppose various possibilities. Let us conceive that one of the three fundamental perceptions is wanting, or that one of the primitive colours is absent: it is clear that the whole chromatic system will be upset. It is evident, therefore, that this system must be completely different, according to the absence of one or the other of the three primitive colours. It is virtually just in this way that it has been attempted to explain cases of a strongly marked defect in the chromatic sense, or genuine types of blindness to colour, found in real life. The term colour-blindness has been justified by this, as it indicates in each case a genuine blindness to one of the primary colours. In this way, therefore, we distinguish, according to the kind of element wanting, three classes of blindness: namely, red-blindness, green-blindness, and violet-blindness."

According to the theory, blindness to red is due to the absence or paralysis of the organs perceiving red. Red-blindness, then, has but two fundamental colours, which, adhering strictly to the theory, are green and violet. The curves in the second diagram distinctly show what aspects the various kinds of light must have for a person who is placed in such a condition.

The red of the spectrum, which feebly excites the perceptive organs of green, and scarcely at all those of violet, must appear to the red-blind as a saturated green of a feeble intensity, more saturated than green as visible to the normal eye, for into this sensible portions of the other primitive colours enter. Feebly luminous red, which affects the perceptive organs of red in a normal eye sufficiently, does not on the other hand sufficiently excite the perceptive organs of green in the red-blind, and it therefore seems to them black. The yellow of the spectrum seems to them a green, saturated and intensely luminous, and, as it constitutes the precisely saturated and very intense shade of that colour, it can be understood how the red-blind select the name of that colour, and call all those tints that are, properly speaking, green, yellow. Green shows, as compared with the preceding colours, a more sensible addition of the other primaries, and it consequently appears like a more intense but whitish shade of the same colours as yellow and red. The greatest intensity of light in the spectrum, according to Seebeck, does not appear to the red-blind to be in the yellow region, as it does to the normal eye, but rather in that of the blue green. In reality, if the excitation of the perceptive organs of green, as it is necessary to assume, is strongest for green, the maximum of the total excitation of the red-blind must be found slightly toward the blue side, because the excitation of the organs perceiving violet is then increased. The white of the red-blind is naturally a combination of their two primitive colours in a determinate proportion, a combination which appears blue-grey to the normal sight; and this is why the red-blind regards as grey the transition colours of the spectrum from green to blue. Then the other colour of the spectrum, which the red-blind call blue, preponderates, because indigo-blue, though somewhat whitish according to their chromatic sense, is to them,

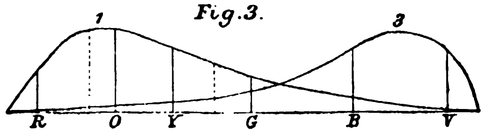
to be of the same colour; and if, in especial cases, he knows how to discriminate between them, his judgment is simply guided by the intensity of the light. The intensity of the light is much more feeble, as shown by diagram 2, in red than in green. If then, a red-blind individual finds that a red and a green tint are exactly alike, the green would, to a normal eye, be much less intense than the red. This is distinctly shown by the vertical dotted lines between R and O, and between Y and G, in Diagram 2, and is also entirely confirmed by experience.

Fig.2.



Green-blindness derives its origin, according to the theory, from the absence or paralysis of the perceptive elements of green. The green-blind has therefore only two fundamental colours, red and violet, and the spectrum for green blindness should be constructed as in diagram 3. In such a

Fig.3.



case the red of the spectrum, which strongly excites the perceptive organs of red, and but very faintly those of violet, must appear to the green-blind as an extremely saturated red, but of a light somewhat less intense than the normal red, which is comparatively more yellowish, as green forms a part of it. The orange of the spectrum is again

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spectrum. Red and green are th
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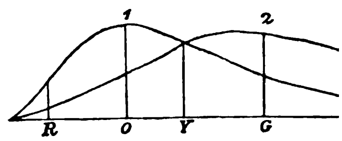
Fig.4.



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r wanting, is yet deficient in acuteness; and iciency may vary greatly in degree. There o cases in which there is a deficiency of ss in respect of all colours, so that, in a nmatic representation of the state of n of such an eye, all three of the curves be drawn lower than the normal, although of them would be absent. Such a con- would imply, manifestly, a diminished ss of perception for white light, that being by the union of the rest, and it is found in es of so-called night blindness, the sub- f which, although able to fulfil ordinary ons in the daylight, almost lose vision on proach of dusk. There can be no difficulty eiving that colour blindness, or rather re colour vision of this kind, may merge bly, as in the progress of disease, into e loss of vision.

he perfectly healthy eye the power of uishing colours varies greatly with the the field of vision from which the colour ls. In order to examine the lateral of the field of vision we use an instru- alled a perimeter, of which I here exhibit the forms. The eye under examination e to look steadily at this central point, a second object is made to glide along c, from its termination towards its centre, arc is shifted from one meridian to another r be required. Now the second or moving first becomes visible in the outer parts of ld, solely by form and not at all by colour, cannot be recognised. Its appearance ls mainly upon whether it be lighter or than its surroundings, and hence the g object, of whatever colour, will appear or grey on a light ground, and white or n a dark ground. As the object advances ers a zone of the field of vision which is ve to violet, next a zone which is sesitive to and sensitiveness to red only commences till later period, while full sensitiveness to ee of the primary colours exists only in the l portion of the retina. With a little e, it is not difficult to hold a red object in position that its form is still visible, while our ceases to be distinguished.

n the basis of the foregoing facts, Professor gren has proposed to divide and classify blindness as follows; and his proposals have d the general assent of those engaged in the igation of the subject:—

Total colour-blindness, in which the faculty ceiving colours is absolutely wanting, and the visual sense consequently can only per- he difference between darkness and light, as s the different degrees of intensity of light.

Partial colour-blindness, in which the faculty tain perceptions of colour, but not of all, is ng. It is sub-divided into—

Complete colour-blindness, in which one of ree fundamental sensations, one of the three tive organs of colour in the retina, is want- paralysed, and in which, consequently, the ed visual field has but two ranges. This includes three kinds, namely:—

Red-blindness.

Green-blindness.

Violet-blindness.

"2. Incomplete colour-blindness, where one of the three kinds of elements, aad perhaps all, are inferior in excitability or in numbers to those of the normal chromatic sense. Incomplete colour blindness exhibits, like the normal sense, three zones in the visual field, but is distinguished from it by an unusually small central field. This group includes the whole of a series of different forms and degrees; a part of which, comprising the superior degrees, might be called incomplete red-blindness, or incomplete green-blindness, or incomplete violet-blindness, and constitutes the transitions to the corresponding kinds of complete colour-blindness; while another part, comprising the inferior degrees, which we call a feeble chromatic sense, constitutes the transition to the normal sense of colours."

Of the varieties thus indicated, two, the complete red-blindness and the complete green-blindness, are overwhelmingly more important than all the rest, and to them, in the subsequent lectures, I shall have chiefly to direct your attention. The violet blindness is a comparatively rare condition, and, in the present state of industry, we are not aware that it is a source of harm or danger to any-one, although it may possibly sometimes be responsible for errors of colour in pictures, in decorations, and in dress. The complete forms of red and green blindness, on the contrary, have been contributory to much destruction of life and property in railway travelling and in steam navigation; and are sufficiently common to have a pressing interest for us all. I may perhaps add, in this place, that whereas there is nothing intrinsically impossible in the supposition that incomplete colour-blindness may be improved by cultivation and practice, there is great weight of evidence, as well as all analogy and probability, in support of the belief that complete colour-blindness is an unalterable condition, upon which educational efforts are simply thrown away. If there are no nerves capable of responding to a given stimulus, the mere repetition of the stimulus will have no tendency to create them.

MISCELLANEOUS.

MEMORIAL TABLETS.

In the year 1864, a letter appeared in this *Journal* (Vol. 12, p. 362) from a correspondent, who suggested that the Society of Arts should offer a prize or prizes for designs of memorial tablets to be affixed to houses associated with distinguished persons, and in the same year a series of suggested inscriptions was reprinted from the *Builder*. The subject having been brought under the notice of the Council, a committee was appointed in 1866 to consider and report how the Society might promote the erection of statues or other memorials of persons eminent in Arts, Manufactures, and Commerce; and, at the first meeting of the committee, on May 7th, Mr. George C. T. Bartley submitted some memoranda on the proposal to place labels on houses in the metropolis known to have been inhabited by celebrated persons. Subsequently, Mr. Bartley prepared an alphabetical list of names of those who were worthy of record, which was printed in several numbers of the *Journal*. In 1867, the first tablet was erected by the Society in Holles-street, Cavendish-square, on the house where Byron was born. Other tablets were soon afterwards put up,

and the erection of these memorials has been continued to the present time. In 1872, Mr. Newmarch, F.R.S., wrote a letter to the Council (see *Journal*, (Vol. 20, p. 492), suggesting certain names, some of which have been commemorated, and Mr. H. D. Pochin contributed £25 for the purpose of carrying out these suggestions. Six new ones, in commemoration of Barry, Hogarth, Newton, Peter the Great, Sheridan, and Walpole, have been erected during the present year. The complete list of tablets to the present time is as follows:—

James Barry..............36, Castle-street, Oxford-street.
Edmund Burke ....37, Gerrard-street, Soho.
Lord Byron ....16, Holles-street.
George Canning ....37, Conduit-street.
John Dryden ....43, Gerrard-street.
Michael Faraday ....2, Blandford-street, Portman-square.
John Flaxman ....7, Buckingham - street, Fitzroy-square.
Benjamin Franklin ....7, Craven-street, Strand.
David Garrick ....5, Adelphi-terrace.
George Frederick Handel ..25, Brook-street.
William Hogarth..........30, Leicester-square.
Samuel Johnson ....17, Gough-square, Fleet-street.
Napoleon III. ....3A, King - street, St. James's.
Lord Nelson ....147, New Bond-street.
Sir Isaac Newton..........35, St. Martin's-street.
Peter the Great ....15, Buckingham - street, Strand.
Sir Joshua Reynolds ......47, Leicester-square.
Richard Brinsley Sheridan..14, Savile-row.
Mrs. Siddons..............27, Upper Baker-street.
Sir Robert Walpole........5, Arlington-street.

The house in Leicester-square, upon which a tablet in memory of Hogarth has been erected, is occupied by Archbishop Tenison's school, for which the house was re-built. The original building, in which Hogarth lived for several years was long known as the "Sablonière Hotel." John Hunter lived next door after Hogarth's death. Of the four worthies who were intimately connected with Leicester-square, viz., Hogarth, Hunter, Newton, and Reynolds, and whose busts are now set up at the four corners of the enclosure, three will be found in the above list.

It is proposed to give in various numbers of the *Journal* representations of the houses upon which memorials have been set up, and the blocks for the four in the present number have been kindly lent by Messrs. Dawson, of the Typographic Etching Company.

The house in St. Martin's-street, which is now occupied by the schools attached to the Orange-street Chapel, is in much the same condition as when Sir Isaac Newton lived in it, from 1710 to 1727, except that the old red bricks have been covered with stucco, and an observatory on the roof has been taken away within the last few years.

Flaxman had several London residences, but the house in Buckingham-street, Fitzroy-square, is the one with which he is most intimately associated, as he lived in it during the prime of his artistic career. He went there in 1796, when he returned from Rome, and there he died in 1826, being buried in the ground adjoining old St. Pancras church, and belonging to the parish of St. Giles-in-the-fields. The house is on the south side of the street, close by Great Titchfield-street.

Canning's house, on the south side of Conduit-street, is greatly changed since the great statesman lived in it. It originally formed a wing of Trinity Chapel, which has been swept away within the last few years. This chapel was the successor of the chapel on wheels which was used at the Hounslow camp in the reign of James II., and was subsequently brought up to London. It is shown in Kip's view of old Burlington-house as standing in the fields at the back of that house. Conduit-street was built, a chapel was erected south side to supersede the chapel on wheels. house on the west side of the chapel, where Ca

Newton's House, St. Martin's-street

lived for a time, was subsequently inhabited fo years by the famous physician, Dr. Elliotson, After his death, the front was altered, and a lar window made, as seen in the accompanying figu is now in the possession of Mr. Streeter, the jew

Flaxman's House, Buckingham-street.

Dr. Johnson had so many residences in Londo there is some difficulty in choosing the one that i interesting to us. The house in Gough-squa special claims to attention, as it was there that th lexicographer chiefly compiled his dictionary. garret, with its slanting roof, in which his aman worked, and his own study are still to be seen. son himself, in his "Life of Milton," observes, "I but remark a kind of respect, perhaps unconsciou to this great man by his biographers; every h

ıh he resided is historically mentioned, as if it were njury to neglect naming any place that he honoured ıis presence." Emboldened by this expression of ıion, Boswell one evening, in the year 1779, ventured

Canning's House.

ık Johnson the names of some of his residences, and obtained the following list, which he printed in his ife of Johnson":—(1) Exeter-street, off Catherine-eet, Strand; (2) Greenwich; (3) Woodstock-street, r Hanover-square; (4) Castle-street, Cavendish-

Johnson's House.

ıare, No. 6; (5) Strand; (6) Boswell-court; (7) and again; (8) Bow-street; (9) Holborn; (10) ıter-lane; (11) Holborn again; (12) Gough-square;) Staple's-inn; (14) Gray's-inn; (15) Inner Temple-lane, No. 1; (16) Johnson's-court, No. 7; (17) Bolt-court, No. 8. In this last place he died in 1784.

In April, 1879, the Corporation of the City of London were asked to co-operate in this work, and to undertake the erection of suitable Memorial Tablets within the City boundaries. The matter was referred to the City Lands Committee, with which body the Secretary has had several communications with respect to the localities suggested for memorials, the result being that the committee agreed to erect such tablets within the City boundaries.

HORTICULTURE IN ALGERIA.

Mons. V. Ch. Joly has communicated a paper on this subject to the Societé d'Horticulture of Paris, of which the following is an abstract:—

The more we advance towards the north, the more we find the taste for horticulture developed, just in the same proportion as where nature does least, necessity will always render man active and industrious. Before speaking of the production of fruits, flowers, and trees, I ought to mention the great question which preoccupies Algeria, namely, the water question; without water, no vegetables, no animals, no colonisation is possible. As there is no stream with a regular course, water is a question of life and death; mere watering is of no use, it must be constant and thorough irrigation. Rain falls only during four months, consequently it is dry for the rest of the year, and this dryness prevents the cultivation of quinine, coffee, indigo, and tea.

The destruction of the forests has done here, as elsewhere, incalculable mischief, and the planting of trees is an urgent necessity. The *Eucalyptus* would render great service. In poor soil the family of the acacias offers species which, besides furnishing firewood, would give an industrial product of great value; by judicious planting in from ten to fifteen years, the climate, now very variable, would be rendered more equable, the springs would be increased, immense pasturages would be restored, and the native population now necessarily nomadic would become settled, and the European element would be more constant. The ruins so frequently met with show that the country was at one time populous, but the destruction of forests led to the destruction of animal and vegetable life. The principal trees met with in the public gardens are the date, Bourbon palm, the *Sabal*, the *Chamærops*, the *Caryota*, the *Areca sapida*, the bamboo, the banana, the *Dracæna draco*, the yucca, the aloe, the *Agave*, besides the *Eucalyptus*, and the plane tree. These last two play a great part in the plantations of new villages, where the engineers form broad boulevards, as they there form an enclosure which rapidly protects the inhabitants against a torrid sun. The *Eucalyptus* especially is the tree of health for low and damp grounds, on account of its great power of evaporation, as well as for its resinous juices; it grows from six to ten feet in height in one year. The temperature and moisture should always be considered as from non-attention to these important factors great waste often occurs, thus the fruit trees of the temperate zone perish quickly in Algeria, while the trees of the South of France, the almond, the jujube, pomegranate, fig, and medlar, ripen two months earlier than in France, and are of the first quality.

Until now, the principal centre of horticultural production has been Algiers and its suburbs. Everywhere irrigation is applied, the water being raised by rough homely instruments, which the labourers like, as they can make and mend them themselves. Near Algiers are the gardens of Madame Rossier, about 10 acres of which are devoted to cultivation of flowers for the local market. At Boufarik, Madame Rossier has also about 18 acres of nurseries of fruit and fruit trees. At the same place

Little has been done to assist nature in the cultivation of flowers in Algeria by man. Although the winters are mild, hothouses are necessary for propagating and for protecting certain plants from the heavy winter rains, or from the summer dust. At Algiers, in the flower market, there were to be seen some cut flowers, but few or none in pots. The flowers to be seen in April were our common ones, roses, geraniums, violets, heliotropes, lilies, heartsease, and pinks. If flowers are little cultivated in Algeria for private houses, they form a considerable industry for perfumery. Thirty years ago, Mons. Simonnet, at Algiers, and Mons. Mercurin, at Chéregas, introduced into the country the planting and distillation of odoriferous plants, since which time this industry has prospered so much, that the geranium alone covers more than 1,300 acres, and furnishes more than 6,000 kilogrammes of essence. The olive, suitably grafted and cultivated, will constitute an immense fortune for the country if it is worked according to its nature; it is thought that the region suitable for it could easily furnish 700 to 800 millions of square feet, producing annually more than 300 millions of francs.

In conclusion, a few words may be mentioned about the most precious plant for Algeria, the vine, which alone is destined to renew the face of the colony. It is planted everywhere from Kabylie (which produces an abundance of table grapes) to Morocco. And this is easily explained when we remember that at the end of five years the cost of the ground, the planting, and expenses of cultivation, is repaid, in addition to a revenue of £20 to £30 the acre. The vines are planted in lines from 5 to 6½ feet apart, to facilitate labour, and a road for carts is left around the plantations. Fortunately no phylloxera has yet appeared, but the curse of the vine in Algeria is the blue fly, which has to be knocked off the vines, and burnt with lime or petroleum. The expense of carriage is the great drawback to the prosperity of Algeria, and if this were lessened, it might become one of the richest colonies in the world.

CORRESPONDENCE.

SCREW PROPELLER.

which finger it is. The presence of
coil of the balance would produce no eff
conductor is necessary. Professor
Gray's fingers ; none of them gave any
to the forefinger of the right hand, whe
coils was quite destroyed, and a noise w
was the very finger in which the filing wa
I need hardly say that Mr. Gray was co

Iron and Steel Institute.—The
this institute will be held this year in
next, October 11th, and following days.
list of papers to be read :—"The Manu
Steel Rails in the United States," by C
(Pittsburg, Pa.) ; "A Method of Secu
the Bessemer Process," by Mr. W. D. A
facture of Ordnance at Woolwich," by
"The Application of Wrought Iron and
facture of Gun Carriages," by Mr. H.
facture of Projectiles," by Mr. J. Da
tribution of Elements in Steel Ingots," b
"The Use of Brown Coal in the Blast
fessor P. Ritter von Tünner (Leoben,
Physical Tests and Properties of Stee
Richards; "The Tin Plate Manufactu
shaw; "The Use of American Anth
Furnace," by Mr. J. Hartman (Phila
in Cast Steel Ingots," by Mr. F. Stu
Progress of the Basic Bessemer Proce
Kupelweiser (Director of the Witkowitz
A number of excursions to works in and
been arranged for the different days of th

Crystal Palace International Elec
The following announcement has appeare
—The second of the series of internat
the Crystal Palace inaugurated this su
Highness the Duke of Connaught will b
tion. It is intended that this exhibitio
in December, and remain open some mo
systems of electric lighting will be repres
Palace, so that manufacturers, theatr
others, who are thinking of applying elec
factories, warehouses, theatres, &c., wil
in England, have an opportunity of co
electric lights and judging for themse
their local circumstances best. The wi
for an electric exhibition, as the seas
lights being seen from 4 p.m., or even
to the many and various systems of
Edison will have a complete exhibit of

AL OF THE SOCIETY OF ARTS.

No. 1,508. VOL. XXIX.

'RIDAY, OCTOBER 14, 1881.

ications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

EEDINGS OF THE SOCIETY.

"OWEN JONES" PRIZES, 1881.

ompetition was instituted in 1878, by the of the Society of Arts, as trustees of the 400, presented to them by the Owen Jones l Committee, being the balance of the ions to that fund, upon trust to expend est thereof in prizes to "Students of the of Art who, in annual competition, pro- best designs for Household Furniture, Wall-papers, and Hangings, Damask, , &c., regulated by the principles laid r Owen Jones." The prizes are awarded results of the annual competition of the nd Art Department.

zes were offered for competition in the ear, each prize consisting of a bound copy . Jones's "Principles of Design" and a Iedal.

ollowing is a list of the successful candi-

ı Fidler, School of Art, Salisbury—Design for t.

Lamb, School of Art, Kidderminster—Design rpet.

s Dutton, School of Art, Nottingham—Design ce.

Phillips, School of Art, Northampton—Design all paper.

; Harris, School of Art, Salisbury—Design for z.

Clulow, School of Art, Macclesfield.

CANTOR LECTURES.

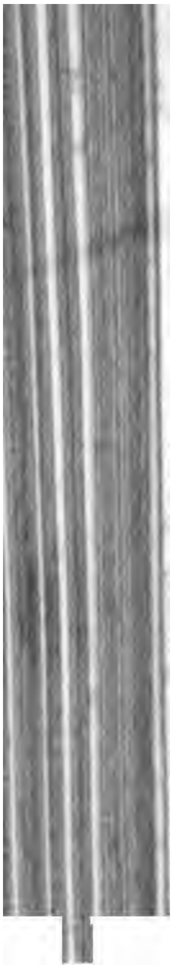
COLOUR BLINDNESS.

By R. Brudenell Carter, F.R.C.S.

E II.—DELIVERED MONDAY, MAY 23, 1881.

of the colour-blind in daily life. Their ls of endeavouring to counteract the conse- of their defect. Modes of testing for colour ess. Sources of error in testing. The actual nce of the affection in this and other countries, different classes of the population.

eavoured, in my former lecture, to explain as is known of the essential nature of lindness; and I proceed to-day to describe the consequences of the defect. I may, perhaps, first be permitted to recapitulate that what we call colour is dependent upon the varying proportions in which different substances destroy the whiteness of the solar light, by subtracting from it some of the elements of which it is composed; that the colours of all natural objects are mixtures, because there is no object which subtracts, either from white or from previously coloured light, the whole of the red, the green, or the violet which it contains; and that the essence of complete colour-blindness is an incapacity on the part of the nerves of vision to respond to the stimulus which one of these three kinds of light is calculated to produce. There is nothing more difficult, even if it be in any way possible, than to realise to ourselves, or to make plain to others by verbal definitions, the nature of sensations of which we have no experience; and hence the precise appearance of the world to the colour-blind, and the difference between their sensations and those of the colour-seeing, must to some extent remain a matter of conjecture. For the purpose of illustration, however, and in order, in the words of old South, to employ those arts by which reason is wont to supply the deficiency of the reports of sense, we may assume what is not quite the case, namely, that white light is composed of red, green, and violet in equal proportions, and that the three colours are of equal luminosity. It would seem to follow, then, that to eyes which are incapable of seeing one of the colours, one-third of the total illumination of natural objects must be extinguished; and hence that the world, to the senses of the colour-blind, must be one-third less bright—one-third less luminous—than it appears to others. It follows, also, that the sensation which we call whiteness must be unknown to the colour-blind. Whiteness is the result of the combination of all three primaries, of which the colour-blind can combine but two. We have here an excellent illustration of the errors which are introduced into the question as soon as we begin to mix up facts with nomenclature. A child, who is, say, red-blind, sees white objects, is told by his elders that they are white, takes his idea of whiteness from their appearance, and would describe them as white to others. Their appearance to him, however, is the same that would be produced to the eyes of the colour-sighted, by an admixture of equal parts of green and violet; and the effect of such an admixture would be the same to him as whiteness, and forms the nearest approach to whiteness that he is capable of seeing or imagining. In the same way, the white of the green-blind is an admixture of red and violet; and the same principle applies to every other colour which may be presented to him. In other words, the colour-blind person loses, out of every mixture, the effect which is produced upon normal eyes by the presence of the element of red, or green, or violet, as the case may be, which that mixture contains, and sees only the remaining elements. That which is invisible to him is practically non-existent for him; and hence, if we have the elements of green and violet in a colour, and no others, the red-blind and the normal sighted would derive the same sensation from them. If we then add the red, the red-blind person would perceive no difference; while, to the colour-sighted, the colour of the mixture would be entirely altered. The former, the red-blind that is, would have no



the electric light; and, with the three colours exposed in approximately correct proportions, will set the wheel into rotation. You no longer see a broad sector of red, a broad sector of green, and a broad sector of violet, but simply a white surface. We will now abolish the red sector, filling the whole circle with green and violet, and then the rotation of the wheel will produce a mixture of those two colours, which most of us would describe as a sort of bluish grey, and which must nearly correspond with the appearance which white surfaces present to the red-blind. In like manner, we will next remove the green, leaving only red and violet, and the violet, leaving only red and green; and in each case the rotation of the wheel will produce some resemblance to the appearance presented by a white surface to the green-blind or to the violet-blind.

It seems probable that, before long, improved means of examining the conditions of colour-blind vision may be furnished to us by the discovery of persons who are colour-blind with one eye only, and who will be able to compare, under proper direction, the impressions derived from the colour-blind eye with those derived from that which is colour-sighted. Two such persons have been recently made the subject of experiment by Professor Holmgren, and no doubt others will be found when looked for, as they will be now that attention has been directed to the fact that they may exist.

Professor Holmgren's two cases were one of one-sided violet-blindness and one of one-sided red-blindness; and he thus describes the results which he has so far obtained from them.

First, the diagnosis of both eyes was carefully made. In both cases there was found a perfect, typical, partial colour-blindness of one of the eyes, the violet-blind on the left, and the red-blind on the right eye; the other eye in each had a weak colour sense, but still was so nearly normal that the principal colours were ascertained with perfect ease. A slight hesitation was shown only in dis-

colour-blind person sees only t
spectrum. These are his two su
colours.

The principal colours in the sp
blind person are, as to their f
red and green. Towards the red
has quite the same extension as
eyed person, and is thus, in con
latter, "unshortened." Reckon
end, his first fundamental colo
that part of the spectrum which
as red, orange, and yellow. First
green, a little on the other side
line D, he sees a narrow unc
white" belt, from which his ot
commences, and is continued w
and more saturated, and afterw
darker shades, over the place wh
greenish-blue, cyan-blue, and in
mencement of the violet, where h
lutely ends with a sharp limit, al
line G. His spectrum is thus at t
ably shortened. The fact that vio
confuse the pigment colours, su
blue, purple and red, orange a
and yellowish green and grey, is
itself. Respecting the tone of
person's subjective fundamental c
said that his red is not quite id
common red of the spectrum of
which is something like cinnaba
clearer red, having a shade of c
same as the red towards the end
spectrum of the normal-eyed.
mental colour, green, is also a cle
the normal eye has a shade of bl

The two principal colours in th
red-blind are, as to their fundame
and blue. The yellow commenc
reckoned from the end, than the
mal-eyed, about Fraunhofer's lin
over the rest of the red, orange,
green, and ends in the blue-green

ng-Helmholtz theory. Regarded from a 'e point of view, we should perhaps have . green instead of yellow as one of the ntal colours. But that yellow, and not that colour, as I have already for some posed, does not shake the basis of that as been shown by Fick and by myself. the tone of the red-blind person's first ntal colour is not perfectly golden yellow, ns for the normal eye to have a shade of -yellow, perhaps best defined as citron- n the lighter, and as olive-green in the hades. His other fundamental colour does to be purely cyan-blue or indigo, but it a blue with a perceptible shade of violet. be called indigo-violet. Perfect clearness eory will not perhaps be gained until we d opportunity of studying more cases of kinds and degrees, and especially a case of erfect green-blindness. Professor Holm- ls that he is preparing a large work upon ect, and the foregoing observations point ossibility that our present conception of en, and violet as the primaries may yet be require some modification.

turn now to the actual mistakes made by ur-blind in daily life, as consequences of fect, we shall find these to be less numerous remarkable than might have been sup- insomuch that nothing has come as a surprise to many persons than the recently knowledge of the great prevalence of dition. Dalton, the chemist, was totally d; and when we hear that he said that ht upper side of a laurel leaf was to him t match for red sealing-wax, while the the leaf was an equally good match for er colour of a red wafer, we are at first lined to think it impossible that such a uld escape recognition, even for a single e compared the colour of a florid com- to a film of diluted ink spread over white and said that blood was not unlike the which he heard called bottle-green. h a member of the Society of Friends, he the street, with perfect complacency, the arlet gown of a Doctor of Civil Laws; and en asked by Whewell what it resembled, was of the same colour as the leaves of rgreens outside the window, and that the hich was of pink silk, was undistinguish- n sky-blue. It would be tedious to enume- ors of the same class which have been . of different colour-blind persons by observers, and which depend, usually , upon some unexpected test being to them in an unusual manner. I am ed with a family in which the father sent e sons, then a boy of nine or ten years old, next room to fetch him a book, which he l as of a green colour. The boy brought ook like this (a red one), and his mistake investigation, which disclosed that he and others were red-blind. In a general way, , the colour-blind manage to avoid , because they soon learn to supplement ective sense by the study of other peculiari- jects. Among children bred in the country, thing which teaches a colour-blind to feel t a difference between himself and other people is, usually, the difficulty which he experi- ences in seeing any difference between ripe fruit or red berries and the leaves which surround them. Even here, it must be remembered, he sees *a* differ- ence, although not *the* difference; because the colour to which he is blind presents to him a sur- face which is deficient in luminosity when compared with others, although he conceives it to be identical in colour. Thus, to quote an illustration from Dr. Joy Jeffries, a child hears people speak of the flowers or buds of the corn poppy as red, and of the leaves and stems as green. He does not per- ceive any ground for this broad distinction; but, seeing that it is made by those around him, and that he is laughed at if he is mistaken with regard to it, he sets himself to work to study carefully the appearances of the flowers and of the leaves respec- tively, and to fix in his memory slight differences, such as an eye capable of perceiving the great difference might easily overlook, and which will, nevertheless, represent to him the former. Thus, he notices slight differences in apparent luminosity of surface, and interprets these as being the same things which others call differences of colour. Unless he happens to be accidentally tested, like the boy of whom I have spoken, with nearly pure red or green, he may not only for a long time escape the detec- tion of other people, but he may even remain un- conscious of his own defect. It must be remem- bered that he sees certain things, and hears them described as red; and that the appearance which they present to him will give him his notion of what it is that other persons mean when they call things red. He may only be detected when some casual event serves to render useless all the fine distinctions which he has acquired; as when the gentleman who was travelling wrote a letter to his family, commencing and completing it at different halting-places, half of it in red ink and half in black, without being himself conscious of the difference. On this part of the subject some very pertinent remarks have been made by Dr. W. Pole, F.R.S., who is himself red-blind, and also by Professor Holmgren. Mr. Pole says:—

"The colour-blind must be very liable to associate, almost indissolubly, the true normal name of a colour with the sensation it conveys to their minds, whatever that sensation may be; and they may, therefore, be easily led to speak of that colour as if they saw it like other people, although the sensation they refer to may be really of quite a different nature to that which the name implies. A colour-blind person will be especially loth to believe that certain colours, which he hears about and talks about every hour of the day, can be invisible to him. Objects of these hues will probably present to his mind some ideas of colour, though not the true ones, and he may naturally imagine, therefore, that he does see them, and may give his description accordingly. And this sort of error is very much enhanced by the fact that it is not an easy matter to refer different tones of any one colour to the same colour sensation; so that a modification of tone, if con- siderable, may be easily supposed to be a different colour. I believe this difficulty is also felt by the normal-eyed; and the popular nomenclature of colours furnishes illustrations of the fact, different tones of the same colour having often different names, and being treated as separate colours. Pink and crimson, lilac and violet, are well acknow- ledged examples of this; and a dark shade of orange is called brown, which generally passes for a separate colour. Hence we may easily see what a great proba- bility there is that the colour-blind may acquire the

one they have the greatest difficulty in comprehending. Hence the very general assertion by the colour-blind that they do see red, an assertion which I think has been far more readily accepted than it ought to be. Red is a more common colour than dark yellow, and hence the preference, by the colour-blind, of the former name for the common sensation. A great variety of bodies are known to be red by habit and association, and are for this reason often named correctly. My own experience is very decided on this point. It is only after long and careful investigation I have come to the conclusion that my sensations of colour are limited to blue and yellow. But, before I found this out, that is, for nearly thirty years of my life, I firmly believed that what I now know to be only differences in tone of one or the other of these were different colours; and hence I was in the habit of talking of red, crimson, scarlet, green, brown, purple, pink, orange, &c., not, of course, with the confidence of the normal-eyed, but still with a full belief that I saw them. If, therefore, at that time, any scientific man had examined me, I should have given him a description of my case, which I now, after more careful study, know would have been utterly wrong. I should have told him, among other incorrect statements, that I saw red objects of a full tone, such as vermilion, soldier's coats, &c., perfectly well; and I could, if necessary, have supported my assertion by naming correctly a great variety of bodies having this colour, which, indeed, I am in the habit of doing every day. It would have been inferred, with great appearance of truth, that I was really impressable with the red sensation; but I now see what an erroneous inference this would have been."

Another source of confusion in interpreting the descriptions of the colour-blind is the want of due appreciation of the different sensations that may be produced on their minds by modified hues of the same general colour. The normal-eyed person considers green, for example, as always green, whether it be yellow-green, blue green, or neutral green; whatever the particular "shade of green," as it is called, it still has, in his eye, the distinguishing character of greenness, which cannot be hidden or disguised by any predominance of blue or yellow

blind, in the words of Holmgre[illegible] main, the same kind of ligh[illegible] observer, but they perceive par[illegible] manner. In the system accordi[illegible] arrange their colours, they have the normal observer; and this obliged to classify under the sa[illegible] portion of the colours classe[illegible] observer under different heads. this that they find resemblances or confuse others, which to the are quite different; for instanc[illegible] These confusions naturally surpr[illegible] normal observer, who readily i[illegible] arise from very great ignorance [illegible] defective training. He ordinar[illegible] there is no limit to the mistakes might make in this respect. B[illegible] case; for each variety of colou[illegible] laws quite as exact as those whi[illegible] pressions of the normal observe[illegible] person can no more accustom [illegible] colours as the normal observer d[illegible] blind can see colours in the sa[illegible] green-blind does, or *vice versa*.

This view of the matter, whi[illegible] experience, explains to us how see colours; but, if we only re[illegible] the names given to colours by we can be easily deceived. To j[illegible] colour-blindness, and of the questions connected with it, it importance distinctly to obse[illegible] between the manner in which person *sees* colours, and the ma[illegible] *names* them. The sensation is nature of the sense of colour in of the optic nerve from birth. [illegible] contrary, is learned. It is conve[illegible] upon exercise and habit. The are naturally the expressions o[illegible] on the other hand, they are

ɪry in cases where, as frequently happens, thods of exploration employed are indecisive, based upon erroneous principles.

n we first think of the condition of the -blind, it is difficult to understand how they il to be immediately detected when in the ny of men endowed with normal sight; but experience shows us that they do escape. In the persons employed upon a railway, for le, who are required night and day to give ion to coloured signals, we usually find that ber of colour-blind are discovered, although defective sense had not previously been ted either by themselves or others, and the ity had correctly performed their duties. s I shall hereafter have to show, the fact of avoided mistakes for some given period ot afford to the colour-blind signalman the est security for the future. His defect will day surely find him out, and that at the very when he is least suspicious of its influence. matter of fact, it is found that the number of -blind persons employed on the American ays has been diminished by the occurrence of kes on their parts which have been attributed relessness, or even to drunkenness, and which led to their being discharged, not as colour- but as bad servants. A recent American says that the colour-blind eliminate them- from railway employment in this way in the of a few years, and that they are never found the old servants of any company. Un- ately, in the process of eliminating them- they have often eliminated other people

methods for testing for colour-blindness be adapted, it is evident, to avoid the sources or which Messrs. Pole and Holmgren have d out as likely to arise from nomenclature, oid those also which might arise from the nt luminosity of the various tests, and to be ly applicable in practice to large numbers of e. All these conditions are fulfilled by Pro- Holmgren's coloured worsteds, and by these ; although there are many other methods of ination which are applicable for different pur- and especially for analysing the precise e and degree of colour-blindness in cases in it has been already discovered to exist.

worst conceivable test, that which on the and would allow a large proportion of the r-blind to escape detection, and which, on her, would cause persons to be set down as r-blind who were not so in reality, is one has been adopted, in pure ignorance, by n railway companies, who profess to test the r-vision of those seeking employment on lines. This test, the worst feature of which haps its superficial appearance of being satis- y and complete, consists in the exhibition of nd green lights, alternately or in irregular ssion, while the candidate is called upon to them as they appear. In order to estimate rocess at its true value, it must be remembered, a red and a green light, under similar con- s of illumination, would not look alike to a r-blind observer, who, if he were red-blind, l see the green light as the more luminous of wo; and, if he were green-blind, would see ed light as the more luminous of the two. Between the two lights, therefore, there would in either case be a distinctive difference of their apparent luminosity; and the person examined would manifestly have more than an even chance of being right in his guess as to which of the two was red and which was green; and would be able, if he were right the first time, to keep right all through the questioning process. An examiner who knew or suspected that the candidate was colour-blind, might be able to lead him into error if he had command of a contrivance by means of which the brightness of each lamp flame, behind the coloured glass, could be increased or diminished; but nothing of this kind has been ordinarily em- ployed for the purpose, and it would at best be a troublesome contrivance. A man who was not colour-blind at all, but only dull, or careless, or imperfectly acquainted with the names of colours, although quite able to distinguish them, might easily call red green, or *vice versa*; and then the question would arise as to how many mistakes in the name of the exposed colour might be accepted as evidence of colour- blindness, or how many correct answers as evidence of colour vision. When thus regarded, it is manifest that the test is worthless; inasmuch as no colour-blind person would be likely to be wrong every time, and many colour-seeing people, of the class from which railway servants are chiefly taken, would be very likely to be wrong occasionally. Besides these objections, there is the further one that no test is satisfactory which rests in the least degree upon nomenclature. The object of the examination is to discover whether some given person sees colour in the same way as the majority of mankind, or in the same way as the colour-blind minority; and what the colours are called, either by the majority or by the minority, has nothing whatever to do with the real question at issue.

Now the principle of Holmgren's method of examination is to compel the colour-blind to reveal themselves by their acts, altogether with- out reference to their language; and for this purpose they are not asked the names of colours, but are directed, from among a large number of coloured objects, to select the tints which match or resemble certain selected patterns which are placed before them. If the persons examined are colour- sighted, they will select only the correct matches for this purpose, while, if they are colour-blind, they will make certain definite mistakes which will disclose the precise nature as well as the existence of their defect, and which could be predicted by any who were previously aware of it. A person who was only careless, or a person who, if such a thing could be conceived, was simulating colour-blindness from mischief or from some other motive, but without adequate knowledge, would, so to speak, make the wrong mistakes, and would thus betray himself at once to a competent examiner.

For the purposes of such an examination, almost any coloured substances might be employed; but skeins of Berlin wool are found to present many practical advantages. They are cheap, easily handled, easily obtainable in every variety of tint, and therefore easily replaced when soiled or injured. Holmgren's full collection consists of about one hundred and fifty skeins, including red, orange,

a piece of worsted work, arranged by Dr. Dane, in which, on some of the lines, the colours which are liable to be confounded are placed in juxta-position. The objection to all schemes of this kind is that the colour-blind have to be asked questions about a sorting which has been already performed by others; while, in the Holmgren method, they reveal themselves with much greater rapidity and certainty when engaged in accomplishing the sorting for themselves.

The time at my disposal does not allow me to repeat the reasons, partly theoretical and partly derived from experience, which have guided Professor Holmgren in the selection of his sample colours; and it is sufficient to say that these are light green, purple, and bright red.

In conducting the examination, the worsteds are placed on a large table, in broad daylight, and on a white cloth. A skein of the test colour is picked out by the examiner, and is laid down at a short distance from the pile. The person examined is then directed to select from the pile the other skeins which resemble the sample in colour, and to place them by the side of the sample. The examiner should first do this himself, and then mix the skeins again, so as to show the examined exactly what is required from him; and, when a large number are to be examined, the instruction should be communicated to all at once, and then each should step forward singly and in turn to make his or her selection. In this way about a minute will suffice for each individual.

The colours which are exhibited on the screen before you, and which are taken from Holmgren's work, are intended to show the nature of the mistakes which exhibit colour-blindness. The plate does not exhaust these mistakes, and shows only those which are most characteristic. The test colours are arranged horizontally; while the colours of confusion, or those which the colour-blind are liable to confound with the former, are arranged vertically beneath them.

In the first place, the green sample is presented

together. The examination n
with this second sample until th
has placed near to it all or the
skeins of the same shade, or el
or separately, one or several sl
He who confuses the colours wi
light or deep shades of blue an
the deep; or the light or deep
of green or grey inclining to
purple, red, and orange, indiscı

He who is colour-blind by the
in the second, selects only purpl
pletely colour-blind.

He who, in the second test, s
only blue and violet, or one of
red-blind.

He who, in the second test, s
only green and grey, or one of
green-blind.

He who, in the second test, mi
with the purple, is *completely vi*

The red-blind never select th
the green-blind, or *vice versâ*; a
in a simple manner, evidence
of the two defects.

With this second test, the ex
concluded; and it is not even nec
to decide whether the blindne
green. But to be more compl
the relation of colour-blindne
colours, and especially in ord
necessary, railway authorities a
not experts, the examination ma
one more trial, which should be
completely colour-blind, and wl
sary to the diagnosis, but which
roborate the results of the prece
For this purpose, a vivid red ske
of a red rather inclining towa
resembling the red used for sign
tion should then be continued u
selected all the skeins belongin
the greater part of them, or else

. A practical difficulty will sometimes he case of incomplete red or green-blind-d the examiner may be asked whether a rson is red-blind or green-blind enough ource of danger to himself or others. We e to deal with a question of degree only; which the expert can do is to reduce the f incomplete colour-blindness to numerical s. When this has been done, it will be uthorities to draw the line of safety.

iis purpose, it must be assumed that a yed person will distinguish the colour of bject at some stated distance; and it fol-t the incompletely colour-blind, who can ve at the same distinction by means of a impression upon their nerves of sight, proach nearer before they can speak with certainty. Hence, the distance of colour the normal-eyed being taken as a standard. ler distance of colour vision in the incom-colour-blind affords at once a numerical of their defect. If the normal-eyed can ish between red and green at ten feet, and npletely red-blind only at five feet, with cts of the same magnitude, and with light ame intensity, the latter may be said to ne-half of the normal acuteness of colour In order to determine the point, Holmgren an apparatus so contrived as to cast shadows, the intensity of which can be d at will; but perhaps the best contrivance purpose is that of Professor Donders, or an s modification of it by Mr. Nettleship. I re Donders's lantern, which carries a pair of g discs, so arranged as to display, to a nder examination, a circle of either red, r green light of larger or smaller sizes; found in practice that, whereas the nor-d distinguish colour as soon, or nearly as they can distinguish the light, the incom-colour-blind have to approach much nearer, shown a much larger circle, before they ve at the same decision with any certainty. Nettleship's lantern, two circles of different can be shown simultaneously and side by l with both of these contrivances a number esting trials may be made.

still to speak of the relative frequency of lindness in this and other countries, and different classes of the population; and on at it is only quite lately, since Holmgren's of examination has been understood and , that any trustworthy statistics have been ble.

xaminations of earlier times, under which colours were held up, and the persons ex-were desired to name them, must be dis-s untrustworthy; and, of all those made t times, I should place most reliance upon k of Professor Holmgren himself, and at of Dr. Joy Jeffries, in America. It e remembered, that all examinations of umbers are apt to be misleading as guides tics, because colour-blindness has a marked ry tendency, so that it constantly affects members of the same family, who, if they be collected in the same school, or within ne locality, may easily fall into the hands ngle examiner, and so vitiate the numerical f his results when these are taken as tests of the amount of colour-blindness in the total population. Professor Holmgren examined 32,155 male persons, described as scholars and children of different ages, young people, railroad *employés*, sailors, soldiers, mill hands, prisoners, and guards, and among these he found 1,037 colour-blind, or a fraction more than 3·25 per cent. Dr. Jeffries examined in New England 10,387 teachers and scholars, and found 431 colour-blind, or 4,149 per cent. In other countries, excepting for occasional results, showing much greater numbers, and where some error has probably crept in, the results are practically much the same, and in all countries the per-centage of colour-blindness is very much smaller among females than among males. Thus, among 7,119 females of all ages, Holmgren found 19 colour-blind, or 0·26 per cent., and Jeffries, among 7,942 female teachers and scholars, found only 4 colour-blind, or 0·52 per cent.

Until the present year, nothing has been known of the actual prevalence of colour-blindness in England, although Wilson, who wrote in 1854, pointed out its frequency, and asserted that it was more frequent among the Society of Friends, and also among the Jewish community than in the general population of the country. In the course of last winter, the Ophthalmological Society of London appointed a committee to inquire into the prevalence of various defects of vision, among which colour-blindness occupied a prominent place; and that committee, of which I have the honour to be a member, made arrangements for testing the colour-vision of the Metropolitan Police, of some of the household troops, and of pupils at various schools. By the indefatigable industry of our honorary secretary, Dr. Brailey, seconded by a large number of gentlemen who gave up the requisite time to the work, no less than 18,088 persons were examined by Holmgren's method in the course of five months. Of these, 16,431 were males, and 1,657 were females. Certain classes of people were especially examined, in the expectation that they would furnish a larger proportion of colour-blinds than the general population. Omitting these classes, we have 14,846 males, with 4·76 per cent. of persons with colour defect, and 489 females, with 0·4 per cent., so that in this country the colour-blind females are only one-tenth the number of the colour-blind males. In fact, the rarity of colour-blindness among women renders them less indulgent towards it than they are towards any other distinctive male weakness; and one of the examiners told me that, in his experience, the first impulse of a mother, when she saw her son picking up a drab to go with a green, or a chocolate with a purple, was to box his ears. I have myself found the impossibility of keeping a mother quiet in such circumstances, and have been compelled to ask her to withdraw into another room until I had satisfied myself upon the point at issue.

The above-stated per centage of 4·67 includes the incompletely colour-blind as well as the complete cases, and the former alone would amount to something like 3·5 per cent. If we confine ourselves to these, and compare the results with those afforded by the selected classes, namely, the members of the Society of Friends, the Jewish community, and the inmates of deaf and dumb asylums, we find that complete colour blindness among the Friends

tions show clearly that the defect has no tendency to cure itself, or to be removed in the course of growth; for, among people of the same class, the percentage was the same in adults as in children. In the same way, among the classes which presented high per-centages, there were more female colour-blinds than among the general population, but the relative proportion of females to males underwent no increase, and the female cases were nearly all slight or incomplete. Among the whole number examined, three of total colour-blindness are said to have been discovered, and a few of violet blindness; but the latter were included among the partial cases and were not made the subjects of any special experiments. Upon the whole, therefore, it may be assumed that, among the classes from which railway drivers and naval look-out men are chiefly derived, a per-centage of more than four and and a half may be regarded as the normal proportion of the completely or incompletely colour-blind; and it will be my endeavour, in the next or concluding lecture of the course, to point out what this means in the way of preventible risk for travellers both by land and sea. There is only too much reason to believe that some of the worst traffic accidents which have happened, both on land and water, including among others the loss of the *Ville de Havre* passenger steamer, were directly due to the want of colour perception in those by whom the courses of one or both of the vessels which came into collision were controlled. On this point, however, I am somewhat anticipating what I shall have to say on the next occasion of my addressing you.

MISCELLANEOUS.

ELECTRIC LIGHTING FOR COAL MINES.*

By Andrew Jamieson.

the possible increased light and safety over the methods hitherto adopted economy and an increased output of expense on labour.

Again, a general and public i awakened in this country when an even attempted to be done, for the be creatures, and more especially whe directed in aid of our helpless broth morning to night, and night to mo dark and dismal bowels of the earth, i us more fortunate beings with the m ourselves with coal for our comfort, p

In attempting, therefore, to place of the leading mechanical and electri case, I hope to be able to interest you and to express a desire that the rema discussion may assist materially in p fecting electric lighting for coal mine

In the first place, I shall review sho already done at the Pleasley and E with an account of the apparatus use periments carried out, and, finally, with what appears to me the simplest and best means for fitting up a colliery

Pleasley Colliery.—In June last, Me ton and Co., in conjunction with Swa Company, laid down at Pleasley Col arrangement of engine, boiler, d leads, lamps, &c., which they placed the Royal Commissioners for Mines i suitability of the Swan lamp, as a m up the shaft bottom, roadways, and coal mines.

The large drawing on the wall gi of the complete system as carried Colliery, near Glasgow, by Messrs. I for Mr. Watson, the proprietor. T from a scale drawing, kindly furnish Mr. Gilchrist, manager of the mine.

Earnock Colliery.—The engine a placed about 260 yards from th engine is 12 N. horse-power, const Shanks, of Arbroath, having their (about one-third of this power being the present installation). A coun

nd insulated with gutta-percha, taped and tarred, whole being enclosed in a galvanised iron tube. same description and size of main leading wire is l along the whole distance of the seam to two king faces, a complete distance of 750 yards from pit-bottom, making the entire distance from the rator to the extreme lamp 1,564 yards, or say 3,128 ds of main leading wire. At each of the twenty- positions shown in the figure is joined up by branch is a Swan lamp, encased in a suitable lantern, sixteen these being fixed lamps, and six portable. The terns containing Swan's lamps were described, they re made from the design of Messrs. D. and G. sham. Each of the twenty-two lamps was provided h an air-tight gravity mercurial contact for the pur- of switching on and off the current. They were uliar in this respect, that upon cutting a lamp out of uit they bring into circuit a wire resistance equiva- to that of the lamp. The primary object of these tight makers or switches is to prevent the spark h is inevitably generated when opening an electric uit from communicating with and exploding the gas fiery mine. Several forms of such air-tight makers been designed by the author in order to prevent ing a spark when joining up a lamp or lead.

e principle upon which the lamps were arranged that of "parallel circuit." This system of joining e lamps is neither the best nor the most econo- l that can be arranged. It necessitates their being early uniform resistance, or of slightly decreasing tance in proportion to their distance along the main in order that the current may be uniformily dis- uted among the lamps, and thus give to each lamp e illuminating power.

t may not be out of place here to mention that a Swan lamp has a resistance when incandescent 0-candle power), of 30 ohms, with an E.M.F. or a ence of potential on its terminals of 45 volts, and, efore, a current of 1·5 weber passing through it. is slightly over 220 candles per h.p. absorbed by lamp. The author has ascertained by actual tests ied out by himself in Glasgow, from a mean of eral lamps tested, that:—

in ... t)	E. M. F. (volts)	Current (webers)	Candle power	Candles per h.-p.	H.-P. per lamp
[illegible]	48	1·7	18	175	·1

f course it must be clearly borne in mind that the her the candle-power at which the lamps are worked greater the (horse-power) economy. If a Swan p were raised to a temperature sufficient to give 600 dles, then we should have about 1,200 candles per se-power. On an average we may consider it a safe tement that ten Swan lamps absorb one-horse power. is does not take into consideration the fact that a tain amount of power is absorbed in the engine, erator, leads, &c., and in making an installation of fifty Swan lamps we may reckon 30 per cent. at st of the power as lost in the manner indicated, ich leaves seven lamps per indicated horse-power, or will require seven indicated horse-power for fifty mps, giving eighteen-candle power each.

It is important to note that the system adopted at rnock Colliery is far from being the best for Swan's mps, in as far as the self-exciting Gramme machine es not readily admit of any automatic current regula- n. For example, if under ordinary circumstances we ve twenty-two lamps in action, and it be desired ddenly to cut out any number of these, say ten or elve, the immediate effect will be that of overstrain- g the remaining lamps by excessive currents. At rnock Colliery, however, an attempt has been made avoid this danger by causing any switch to introduce esistance equivalent to that of the lamp which it cuts out. It will at once be seen that this is an uneconomi- cal expedient, because the resistance thus introduced absorbs power equal to that previously absorbed by the lamp now cut out. If a Siemens's alternate current machine (with separate exciter for magnets) be used, then the E.M.F. remains practically constant whatever change is made in the number of lamps in circuit, and thus without any direct current regulator the lamps are never endangered.

This is a very great improvement upon the self-exciting Gramme or Siemens machine, and entirely does away with the necessity for a specially constructed system of automatic current regulator. It, therefore, simplifies the mechanical arrangements, and does away with the danger and inconveniences arising from turn- ing off or putting on a number of lamps (within the limits of the machine).

These alternate current machines of Siemens also admit of burning an arc light in conjunction with and fed from the same machine as the Swan incandescent lamps; this is advantageous for surface lighting.

I cannot do better than indicate how I would propose to carry out a system of electric lighting for colliery purposes than by reviewing what I have purposed, with Mr. Swan's concurrence and approval, for Eppleton and Houghton pits, near Hetton, Durham.

1. The motive power to be Marshall and Sons best made horizontal engines, with their specially con- structed automatic governor.
2. Siemens's exciter and alternate current machines.
3. Leading wire by Silvertown India - rubber and Gutta-percha Company, No. 1,092, having resistance of less than ½ ohm per 1,000 yards.
4. Swan's lamps encased in specially-designed strong lanterns. Those that are fixed to have hemispherical glass globes and copper-silvered reflectors, suited for projecting the lights downwards or along the gallery or seam as desired; and those that are movable to be placed in lanterns like one or other of those before you, only lighter or more handy, specially strong 100-candle power Swan lamps being provided for the screens and other places where a strong light is desired.
5. For the open space surface works, and where the railway and surface haulage takes place, Siemens's (alternate current) arc lights are proposed, suitably placed to admit of working at night with a readiness and celerity almost equal to that in the day time.
6. Ayrton and Perry's electro dynamometers for measuring the strength of the electric current.
7. Velocimeter, switches, &c., as per specification.

The complete specification and estimate is drawn up with a view of entirely superseding gas and oil on the surface works, the three coal seams, and for stables and haulage near shaft, but not to be continued to the front at present, the distance being very great (two to three miles).

[At the same meeting Mr. Swan showed a miner's lamp, in which one of his incandescent lamps was com- bined with a small Faure accumulator, so that it could be charged, say, at the pit's mouth, and then entirely disconnected. By this means the lamp was rendered portable. Mr. Swan stated that this arrangement gave light for about six hours.]

NEW TOWN AT WAYNE, UNITED STATES.

The following account of a new town, for 3,000 in- habitants, to be built by Messrs. George W. Childs, of the *Public Ledger*, and A. J. Drexel, banker, is taken from an American paper:—

"Within a period of three years, the real estate along the line of the Pennsylvania Railroad has appre- ciated in value to the extent of 18,000,000 dollars. The first step in this extraordinary development was made ten years ago, when the Pennsylvania Railroad Company

bought 600 acres of land near White Hall, changed the line, named the new station Bryn Mawr, divided it into building lots, and sold it under such restrictions as to attract the wealthiest classes of the community to that section. It was about a year ago that Messrs. Childs and Drexel bought 600 acres of land, at Wayne Station, for 240,000 dollars, the tract having a frontage of a mile and a-half on Lancaster avenue, and on the railroad. It is the purpose of these gentlemen to divide the land into building lots of about an acre each, to erect artistic cottages, ranging in price from 2,000 dollars to 8,000 dollars, and to dispose of the houses and lots upon payment of about one-third the cost, Messrs. Childs and Drexel advancing two-thirds, thus affording to folks in moderate circumstances an opportunity of securing suburban residences upon reasonable terms. Within two minutes' walk of the new station, Mr. Childs has built the Bellevue Hotel, an ornate drab structure, in Queen Anne style, with porches on every side, which rise in tiers to the fourth floor. At the lower end of the tract another hotel, to be called the "Audubon," and capable of accommodating 150 guests, will be erected. Surrounding these properties and on Lancaster avenue will be five hundred residences, laid out on avenues having a uniform width of 60 feet, and footways from 12 to 15 feet wide. The houses recede 40 feet from the line of the avenue. Ornamental trees will be planted on either side. The roadway will be macadamized, and, with the forty-foot lawn between the house line and the footway, there will be a width of 170 feet between buildings on opposite sides of the avenue. To improve the landscape, Mr. Charles Miller, the chief of the Horticultural Department at the Centennial Exhibition, the Fairmount-park gardener, and the designer of the beautiful grounds at Woolton, Mr. Childs's country residence, has been engaged. The drainage system is under the supervision of Colonel George F. Waring, the sanitary engineer, whose advice was sought lately regarding the condition of the Executive Mansion at Washington. The water supply system, devised by Mr. Isaac S. Cassin, is now complete. It will supply a population of 20,000 people. The reservoir, covering nearly an acre of ground, and holding 250,000 gallons of water, is located on a knoll at the western end of the track, at an elevation of 450 feet above tide-water, giving a head of 82 feet. The water is supplied by springs, and is pumped from a pretty lake, where the flow of Ithan Creek is retained. More than two miles of six-inch distributing mains have been laid along the various avenues, the water works have been in practical operation for seven weeks, and everything is in shape to make connection when the buildings have been erected. At a short distance west of the Childs-Drexel property was the Spread Eagle Hotel property, a well-known stopping place on the Conestoga-road, where liquors were sold. This property was purchased by the two capitalists in order that no spirituous liquors might be sold near the site of their new city.

GENERAL NOTES.

Howard Medal Essays.—The Council of the Statistical have again decided to grant the sum of £20 to the writer who may gain the "Howard Medal" in November, 1882. The essays to be sent in on or before 30th June, 1882. The subject is—"On the State of the Prisons of England and Wales in the Eighteenth Century, and its Influence on the Severity and Spread of Small-pox among the English population at that period." The essays also to present a comparison of the mortality by small-pox among the prison population of England and Wales during the eighteenth century, with the mortality from the same cause during the last twenty years. Further particulars or explanations may be obtained from the Assistant Secretary, at the Office of the Society, King's College Entrance, Strand, W.C., London.

School of Art Wood-carving.—The School of Art Wood-carving has re-opened after the usual summer vacation. Free studentships in both the day classes and the evening classes are at present vacant. These studentships are maintained out of funds provided by the City and Guilds of London Institute for the Advancement of Technical Education. The necessary information, with forms of application and prospectuses of the school, may be obtained by letter, addressed to the Secretary, School of Art Wood-carving, Royal Albert Hall, Kensington, S.W.

Melting Steel.—On Tuesday, October 11th, the members of the Iron and Steel Institute visited the Telegraph Construction Works of Messrs. Siemens Brothers, at Charlton, on which occasion Dr. Siemens, F.R.S., exhibited his experiment of melting steel by means of the dynamo-electric current, when five pounds of steel were melted in five-and-twenty minutes. The apparatus employed consists of an ordinary crucible of plumbago, or other highly refractory material, placed in a metallic jacket, or outer casing, the intervening space being filled up with pounded charcoal, or other bad conductor of heat. A hole is pierced through the bottom of a crucible for the admission of a rod of iron platinum or dense carbon, and the cover of the crucible is pierced for the reception of the negative electrode, which is suspended at one end of a beam by means of a strip of copper. The other end of the beam is attached to a hollow cylinder of soft iron, free to move vertically within a wire solenoid, one end of which is connected with the positive, and the other with the negative pole, of the electrical arc.

Anderson's College.—Dr. Mills, F.R.S., "Young" Professor of Technical Chemistry at Anderson's College, Glasgow, has issued a syllabus for the session 1881-82:—A course of fifty lectures will be delivered on Mondays, Tuesdays, and Wednesdays, at 10 a.m., commencing on November 7th. The lectures will be illustrated with experiments, diagrams, and models, as well as by the actual inspection of manufacturing processes; and the progress of the students will be tested by periodical examinations. The earlier lectures will have reference to units of weight and measure, to the calculations necessitated by chemical operations, and to the nature and laws both of the chemical process and its results. A particular subject will then be considered in comparatively minute detail, embracing for this session dyeing and printing. A subsequent course of thirty lectures will be delivered, which are more particularly intended for dyers, colour manufacturers, brewers and distillers, tar rectifiers, drysalters, and others interested in a knowledge of technical organic chemistry. Mr. J. Snodgrass, senior assistant, has arranged to deliver a series of [illegible] lectures and demonstrations on physico-chemical measurements, and also a course of evening lectures on iron and steel manufacture, in time for the May examination.

Ladies' Sanitary Association.—A Second Series of nine lectures on "Domestic Sanitation" will be delivered by Dr. Richardson, F.R.S., in the Lower-hall, Exeter-hall, Strand, during October, November, and December. In this course of lectures the structure and functions of the nervous system of man will be presented. The physical and mental training of the young will be considered in this division. The lectures will be illustrated by the oxy-hydrogen lantern. The first lecture will be delivered on Saturday, October 22nd, at 5 p.m., and will be continued on following Saturdays until December 17th. Tickets for the Course, one guinea (transferable). Single tickets, reserved seats, 3s., may be obtained of the Secretary, Miss [illegible] Adams, at the office of the association, 22, Berners-street, W. Unreserved seats, 1s., by payment at the door. Six prizes will be awarded to the most proficient students as follows:—First Morley Prize of Ten Guineas, and Second Morley Prize of Five Guineas, given by Mr. Samuel Morley, M.P.; Prize of Three Guineas, given by Miss Marshall; Prize of Two Guineas, given by Mrs. Richardson; Prize of One Guinea, given by Lady Mount-Temple; Prize of One Pound, "Consolation," given by Mr. W. Phillips. Certificates of first and second-class merit will also be awarded.

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ications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

EEDINGS OF THE SOCIETY.

CANTOR LECTURES.

COLOUR BLINDNESS.

By R. Brudenell Carter, F.R.C.S.

III.—DELIVERED MONDAY, MAY 30, 1881.

s chiefly affected by colour-blindness—-drivers, pilots, artists, letter-sorters, , painters, &c., &c. Recent legislation g colour-blindness in America, and urgent r it in this country. Conclusion.

course of the two preceding lectures, I eavoured to show that the sense of colour upon the nature of the light which is ted from visible objects, and that what is olour-blindness depends upon want of ness, on the part of the optic nerve, to par- agnitudes of wave vibration, so that the nsations which these vibrations excite in yes are not perceived, and the correspond- urs are invisible, and are lost out of all the es into which they normally enter. Thus, g at what we call purple, which is a mix- ed and violet, the person who is blind to in it only its violet element, and selects violet to be a match with it. The red- a similar manner, loses the red element colours or mixtures of colours, and the ind loses the green element; while, to he latter, the difference between red and imperceptible, except as a difference of ss or luminosity; green appearing the of the two to the red-blind, and red to n-blind. In the case of persons who are tely red-blind, or incompletely green- e difference between the two colours is gnised as a difference of luminosity at a and becomes recognised as a difference of a nearer approach; the precise point at e difference of colour becomes apparent for equal luminosities, very widely in cases, and furnishing a measure of the the defect.

already mentioned that there are a few total colour-blindness, or of people who ing but form and light and shade, but d also blindness to violet, are of such rare ce, that practically they scarcely call for ation. My chief business to-night is to he bearing of red-blindness or of green-blindness, either complete or incomplete, upon the fitness of the subjects of these defects to engage in certain industries, of which those which call for the recognition of railway and marine signals are the chief.

If we take as an illustration, in the first instance, the state of an engine driver who is completely red-blind, and who is called upon to govern the course of a locomotive in obedience to certain coloured signals, which may be either red and green alone, or white and red and green, in accordance with the regulations of different roads, we find that these signals present to him differences by which, in many cases, he can tell them apart; but these differences are of brightness, or luminosity, and not of colour. From the white light he receives the whole of its green and violet, the red being lost to him, so that what he sees is a blue gray, comparatively feeble in brightness when contrasted with the impression made by the same light upon a normal eye. The green light will be removed still farther from the brightness by reason of its preponderance of green, and the red will only be visible by means of the rays other than red which the red glass transmits, and if nothing but red was transmitted, would be invisible altogether, so as to be what an Irishman might perhaps call a dark light. For practical purposes, however, we may omit the white lights from consideration, and may fix our attention only upon the red and green. Of these, the former, to a red-blind man, would seem darker than the latter; and this reflection would be reversed in the case of a green-blind. We may perfectly well suppose the colour-blind person, in either case, to be unconscious of his defect. He has all his life been accustomed to interpret the phrase "a red light" as meaning something which presents to him a dim or feeble illumination, and to interpret the phrase "a green light" as something which presents to him a stronger or brighter illumination. By the help of this distinction, he may pass an examination which is inadequately conducted, and he may drive his engine for long periods without accident or mistake. But the point at issue is that he is compelled to rely upon an unreal distinction, a distinction of relative brightness only; and that his judgment upon this relative brightness is liable to be misled by accidental circumstances. Anything which increased the apparent brightness of the red light, as, for instance, a better burning, or even a quite recently lighted lamp, a red glass of less thickness or slightly different tone, or of less absorbing power than usual, these and many other other possible variations would lead him to mistake a red light for a green one. In the same way, anything which diminished the apparent brightness of a green light, as a thicker or more absorbing glass, a badly burning lamp, the intervention of steam, smoke, or fog, would render him liable to commit the comparatively harmless mistake of taking a green light for a red one. To the green-blind, on the other hand, the reverse conditions would obtain. To him, the green light would be comparatively dim, and the red one comparatively bright; so that any of the conditions which would brighten the red light and make it more conspicuous to the normal sighted, would render it more like green to the green-blind, and would directly serve to tempt him into danger. It has been well

observed by Dr. Joy Jeffries that no right minded and conscientious person would undertake the guidance of a train, on the announced condition that, in any variations of atmosphere and weather, he was to recognise a dim light as a danger signal, and a bright light as a safety signal, and *vice versa*, and that his own life, and the lives of the passengers, were to be dependent upon his always rightly determining which was which.

It has often been maintained that we hear very little of accidents actually arising from colour-blindness; but it must be remembered that, until quite lately, this cause of neglect or mistake of signals was scarcely recognised by those whose duty it is to investigate such occurrences. At the present day, the first inquiry which would be made, in any case of over-running a danger signal, would have reference to the colour vision of the man in charge of the engine; but, even so lately as two years ago, the point would have been likely to be wholly overlooked. Admitting, as must no doubt be done, that the calling of an engine driver affords no immunity from colour-blindness, and that the colour-blind engaged in it, in default of measures for their discovery and rejection, are in the ordinary proportion of from four to six per cent., it is almost assuming a miracle if we say that accidents have not happened from conditions apparently certain to produce them.

The latest statistics of the examination of persons employed on railways with which I am acquainted are those collected by Dr. Joy Jeffries; and, in estimating their significance, it is necessary to remember what I mentioned in a previous lecture, that colour-blind railway servants have a tendency to eliminate themselves from their situations, by mistakes which do not lead to accidents, but which are noticed by their superiors, and are set down to drunkenness or carelessness, and held to require dismissal. Notwithstanding this:—

Dr. Hansen, a distinguished ophthalmic surgeon of Copenhagen, of whom I may observe in passing that my personal knowledge of him would lead me to place implicit reliance in the accuracy of his observations, states that among 1,034 railway servants in Denmark, there were 31 colour-blind, or 2·87 per cent.

Dr. Stilling, of Cassel, reports 24 colour-blind among 400 railway servants, or 6 per cent.

Dr. Magnus, of Breslau, reports four per cent. among railway servants tested by one of his colleagues, but does not give the total number examined.

Professor Donders, of Utrecht, with the assistance of Dr. Bouvin, examined 2,203 of the *employés* on the Dutch railroads, and found 152 colour-blind, or 6·9 per cent.

Dr. Von Reuss found 3·50 per cent. of colour-blind among 800 *employés* of one of the Vienna roads.

In the Swedish army, Professor Holmgren found 60 colour-blind among 2,200 men, or 2·7 per cent., and used this fact as a means of obtaining an examination of the railway servants throughout the country. In the first 266 men tested, there were 13 colour-blind, or 4·8 per cent., and the Professor has since examined 7,953, among whom there were 171 colour-blind, or 2·15 per cent. In Finland, there were 60 colour-blind among 1,200 railway servants, or 5·0 per cent., the examination being conducted by Dr. L. Krohn, after instruction by Professor Holmgren in his method. Nearly the whole of these examinations were conducted in the latter part of 1877; and they show that at that time, in the comparatively small amount of mileage and extent of country which they cover, there were no less than 479 colour-blind persons engaged in the actual conduct of railway traffic. These figures include all sorts of people, drivers, stokers, pointsmen, porters, and the like, for many of whom, in their ordinary occupations, their defect might not be a source of danger, but who would be liable, in all probability, to be concerned in signalling or in obeying signals, at least sometimes. It is a significant fact that some among them were station-masters.

Dr. Joy Jeffries quotes from Dr. Minder, of Berne, a narrative which is of sufficient interest to be repeated. Among Dr. Minder's cases was that of "a very intelligent young man who was red-blind, but was not aware of it. He held the position first of stoker, and then of driver on one of the Swiss roads. He was hardly at work before his defect troubled him. Thinking it was due to the spirit he drank, he stopped this for a while; but, the trouble continuing, he became convinced that 'something was wrong with him about the colours,' and left the recognition of the signals to his normal-sighted assistant. When another man, who seems also to have been colour-blind, took this assistant's place, the work began to be 'uncomfortable.' The red-blind driver had no one to correct him; and, as he was very frequently mistaken in his conclusions, there occurred a series of mistakes, fortunately only while manoeuvring in stations, which brought upon him occasional fines and other disagreeable consequences.

"The red signal lantern gave him the most trouble, because, as he said, he could only distinguish it when so near with his engine as not to be able to stop, and hence often ran by it. He did better with the green signal; and, when asked why, replied, 'because it was brighter.' To the question how, then, could he tell the green signal from white, he, in a roundabout way, compared green to weak white; and stated that, with a lantern of white glass, he could, by screwing the wick up and down, and thereby changing the amount of light, himself imitate the usual railway signals. Very bright light was white; very weak light, red; medium intensity, green—in complete correspondence with the statements based by Holmgren upon the Young-Helmholtz theory. The apparent impossibility of his power of distinguishing between the lights being dependent only on their relative intensities induced me to search farther, and to ascertain what a complete colour-blind understood by pure white. A whole series of colour-blind persons were expressly asked to select only the purest white from among the test objects presented to them. Of worsteds and papers they picked out, besides the white, several shades of bright green, gray, pure gray and dirty gray, light rose, and very light violet." This entirely corresponds, it will be observed, with the illustration of the appearance of white to the colour-blind which was given by means of revolving discs in my last lecture, and which we will repeat on the present occasion.

In my first lecture I mentioned as a matter of probability, and was misreported in some papers as having stated as a fact, that there are in the United Kingdom more than 400 colour-blind engine drivers. As far as I am aware, the facts have not been ascertained, and my statement was based upon these grounds. According to the Board of Trade returns, the locomotives in use in the United Kingdom during the year 1879 were 13,174. There is no information with regard to the number of these which were in actual running order; but the statistics of the South-Eastern Railway, for the successive half-years between June, 1875, and December, 1879, show an average of 73·3 per cent. of the locomotives as running at any given time, while 26·7 per cent. were in the shops under repair. On the basis of these figures, kindly furnished to me by Mr. Price Williams, I assume that, of the above-mentioned 13,174 locomotives, 70·0 per cent., or 9,222, were always in running order, and were therefore giving employment to the same number of drivers. I assume farther that, among these 9,222 engine drivers, little or nothing having been done to weed out the colour-blind, there will be the same proportion of this defect which has been recently discovered in the Metropolitan Police, or 4·67 per cent. This percentage, upon the number stated, would give a total of 424 colour-blind men.

The question may here be fairly asked, whether it is true that little or nothing has been done to weed out the colour-blind from such an employment as engine-driving; and I fear there can be no doubt that the answer must be in the affirmative. I do not know of any official returns upon the point, and I have been told that some companies have instituted an examination into the colour-vision of their servants, and of all candidates for employment. This is no doubt highly satisfactory as far as it goes, and may at least lead to effectual precautions in the future, but there is no evidence that it has accomplished anything at present. The subject is a new one; or rather, as I have already stated, it is one which has only recently emerged from the position of a matter of scientific curiosity into that of a matter of practical importance. The attitude of mind of railway authorities with regard to it was, in the first instance, that attitude of passive resistance which the human mind is so apt to assume in the presence of suggestions for improvement. It is a familiar saying that people meet every discovery by first saying that it isn't true, then that it isn't new, next, that they have always known it. Now the first suggestions that colour-blindness was a common affection, and a source of actual peril in railway working, were met with absolute denial and entire incredulty. As soon as the railway authorities were driven from this first line of defence, some of them said "well, we will institute examinations." At this stage they seem to have believed, I think not unnaturally, that the question was a very simple one, which anybody was competent to decide; and the result of this was that they committed the examinations to the hands of incompetent persons, who used methods which, as I showed in a previous lecture, were not only valueless, but misleading. The truth is, that the testing of colour-vision, in a way to be at once fair to the employers and to the servants, is a matter which requires very considerable practical experience not only of this particular defect, but also of the methods of testing vision generally. I believe it to be impossible for any but experts to conduct the examination of a large number of men at once with correctness and with accuracy, and I have no doubt that serious errors have been committed from the want of recognition of this fact. I may be pardoned for pointing out that even the medical officers of a line of railway, whose ordinary duties have little or no relation to vision, are not always experts with regard to it; while the examiner often employed, some worthy person who has been promoted from being a porter to be an inspector, would be sure to blunder in every direction, and, in the rashness of pure ignorance, would constantly decide upon inadequate grounds. I have heard, although I do not vouch for the truth of the statement, that the examiner employed upon one line of railway, was himself, after he had been for some time engaged in the duty, accidentally discovered to be colour-blind; and it is astonishing how few persons, even of fair education and ordinary intelligence, are at first able to emancipate themselves from the confusion incidental to the correct or incorrect use of colour-names, which, as I have already pointed out, have no necessary connection with colour-vision. In the report drawn up by Dr. Brailey, for the committee of the Ophthalmological Society, from which I have already quoted the statistics of colour-blindness in England, I find the following passage, which is based upon his observation of the examination of more than 18,000 persons, by 16 highly competent observers. He says:—"The value of the service rendered by the examiners has in most cases been enhanced by its having extended over the whole five months during which the facts have been accumulated; so that increasing skill has been attained, and more uniformity of result has been secured. Your secretary becomes more and more convinced that a competent examiner is not made in a day, or even in a month; and that, even with large experience, much judgment and capacity are needful to interpret rightly the acts of the examined, whether educated or uneducated. This necessity is perhaps most strongly exhibited in the case of the partial colour-blinds of intelligence; who, although they may have a much feebler appreciation of the difference between red and green, for example, than the normal, may, after accurate observation and comparison, separate the red wools from the green. When tested, however, with coloured lights, their defects come out strikingly; and it becomes clear that they are totally unfit for responsible posts in which rapid appreciation of colour at a distance is required."

A remarkable instance of the difficulties which are sometimes placed in the way of the examiner, and of the care and skill and knowledge which he may be required to exercise, is furnished by a narrative contained in the last annual report of the Supervising Surgeon-General of the Marine Hospital Service of the United States. The narrative is too long for quotation, but I will endeavour to condense its most essential features. It is in the form of a report, by Surgeon Hutton, on the case of a colour-blind pilot at Detroit.

According to the rules issued last year by the United States Government, all persons applying

that attempts have been made in the United States to make political capital out of the question of colour-blindness, and that hence the authorities have been somewhat hampered in their efforts to deal with it on scientific and practical grounds alone, and have been led from time to time to modify, out of consideration for cases of real or supposed hardship, the rules under which their officers are instructed to act.

On the 21st of August, a prominent citizen and shipmaster of Detroit was sent to Surgeon Hutton for examination, and was reported by him to be completely colour-blind. The local and supervising inspectors called upon the surgeon to suggest that there must be a mistake, saying that the applicant had sailed vessels for 32 years, 24 of them under a pilot's license, that some, if not all, of the inspectors had sailed with him, and were certain that he could distinguish coloured lights as well as the best, and that he had never made a mistake or met with an accident. They wished to have a certificate of incomplete instead of one of complete colour-blindness, as the former would have referred back the matter to them, while the latter left them powerless. Mr. Hutton replied that the applicant was either completely colour-blind, or not colour-blind at all; but he accepted the invitation of the inspectors to see him informally tested with coloured lights. A room in the Custom-house was darkened, and a lantern was so arranged so as to show either a white, a red, or a green light, and was placed at 20 or 25 feet from the person examined. The light used was about six inches in diameter, but being transmitted through a bull's-eye appeared larger, say eight inches in diameter. Several times the examined pronounced the red to be green, the white to be green, and sometimes the green to be red. Splitting the light so as to show the port or left half as red, and the starboard or right half as green, precisely as they appear as to position on shipboard, he every time said both sides or halves were green, but of different

2 yellow-green. About an ho
occupied in the investigation, a
the test sample in one hand,
pared with it every other wl
Dozens of skeins of each colour
and rejected.

Four skeins each of good gre
then taken from the pile, mi
placed apart. Asked how ma
replied, eight, of course. He
four were of a good green, and f
and was asked to separate them
greens. In his best endeavours
each, but more frequently all,
greys, saying, as to the greens,
reddish cast.

After a variety of other tests
the same results, the applicant
the streets and on the river, at ni
and by the inspectors, who stat
readily distinguish red and gre
stores and on vessels. They appe
Hutton, saying that it was impo
him with coloured lights in th
shipping in the harbour. These
so persistent that a practical tria
arranged. After an examination
by gas light, in which the sa
made as in the day, the party p
streets, and from here I take Mr
"Three or four blocks away, up
series of four red and six green li
a triangular form over a saloon,
These he properly described; a
light on a car on Larned-street.
ward-avenue, two street cars a b
ing side by side, one showing a g
a bright light, were pointed out
The bright light was pronounce
green light was pronounced red.
were made to have him correct h
persistently adhered to his st
green light was red and the brigh

ne, but no other. Three moving red lights perly named. Three of same in opposite were made out as two only. He 'saw' hts when none existed; also, in one instance, out a red light when none existed. On hes of the Great Western Railroad he t both red and green lights, but it was le to separate them. Returning to Detroit, made mistakes as to street-car lights. along Woodward-avenue, we stopped Frizell's drug store, in the windows of ere eight coloured globes, red, green, and In order that no mistakes, as to the light ur examined, might be made, the super-nspector crossed over, and with his cane them out one by one; of the eight coloured ll brilliantly lighted, he properly named ow; a green globe he said was red, and a e three or four feet above the green he green.

d entered upon this last task with the ation that if the applicant made no mis- the test, as some of the inspectors and icant were so confident he would not do, I ive him the benefit of it so far as it lay in city, and would proceed to criticise the thiness of the worsted tests. But, when lights of which he knew nothing, it con- hat I decided within five minutes after cing the first examination, and showed r diagnosis of completely colour-blind tand. So far as the test on the river vessels is concerned, I maintain that it is t all. Vessel lights have fixed positions. ess of mental calculation, coupled with his ge of the relative positions of these lights, him to decide the matter, after a little n as to the position and course of the ndependently of his chromatic sense.

amusing instance corroborative of my is occurred on the last morning. He walked office remarking, 'Doctor, you say I am y colour-blind; you *know* I can see red; you.' Walking up to the table on which ad the worsted—and although, in order to n the benefit of every doubt, I had pur- dozen or so of samples of the brightest k, blue, and green, and put away all doubt- les—he seized a skein, and approached me, ng, 'there is as good a red as God Almighty de.' However, it was the best of brown."

k there can be no doubt that the applicant oregoing case, if it had not been for the of Mr. Hutton in the discharge of his ould have been referred to the inspectors her examination, and would by them have rmitted to return to his avocation, on the h of the insufficient test furnished by the hich he applied to the moving lights of ips.

colour-blindness constitutes a real peril in duct of navigation is curiously illustrated eport for the current year of the railroad sioners for the State of Connecticut, who e hear less frequently the question so common ths ago, "Who ever heard of an accident lour-blindness?" Many accidents which, e fact of colour-blindness was less known, unaccountable, are now found to have all racteristics which would be expected in accidents from colour-blindness, and in some instances the proof is conclusive. The following is a remarkable instance of this.

A few years ago a collision occurred near Norfolk, Virginia, between the tugboat *Lumberman* and the steamship *Isaac Bell*, resulting in the loss of ten lives. A coroner's inquest was held without definite result, the general impression being that one or the other of the pilots was intoxicated. There was no proof of this, however, and the pilots were released. The pilot of the tugboat *Lumberman* was examined by the surgeon of the marine hospital service, during the current quarter, and found to be colour-blind. A rumour has reached the marine hospital bureau that the pilot of the *Isaac Bell* is also colour-blind.

Evidence, uncertain it is true, but of some weight, of accidents through colour-blindness may be found in the results of our Connecticut examinations. Dr. Carmalt says that he found no engineer over 31 years of age who was colour-blind, and the total average was only three per cent. in the State. Now, as it is agreed that about four per cent, is the average among men, and as our men examined were largely old *employés*, we may fairly assume that about one per cent. had been eliminated through mistakes, in fact caused by colour-blindness, but, as that was not thought of at the time, they were discharged for what was called carelessness.

In the face of the facts and arguments already stated, it becomes a serious question what precautions should be taken by the governing bodies of railways, if necessary under compulsion from the legislature, to secure the traffic of their respective lines against the risks which colour-blindness seems in the long run certain to entail. Considering the extent and character of these risks, and the inadequacy of any other defence against them, I think it is not too much to require that the colour-blind, for the future, should be absolutely excluded from railway or naval employment. The absolute number of persons affected by such a provision would, no doubt, be large; but the comparative number would be small; and there is no real hardship in excluding four per cent. of the male population from duties which they are not qualified to fulfil. The subject is one which might with great advantage be taken up by the amalgamated engineers and other trade societies, or, better still, by school boards, with a view to the early testing of the colour vision of children and of candidates for apprenticeship, and in order to exclude the colour-blind from occupations for which they are unfit, before they had spent time in preparing for them. Failing this, a strict examination should certainly be instituted by all railway companies, and no man should be permitted to enter their service, in any position in which colour-vision was or might be required from him, unless the results of the examination were entirely satisfactory.

It is strongly held by the majority of ophthalmic surgeons that every such examination should be conducted by trained experts; and in the United States, where this opinion has already found legislative expression, it is certain that passengers would not consider their safety adequately provided for, and that engine drivers and others would not submit to be condemned, by any verdict save that

examine the cases referred to them at some stated fee, and then to say to candidates for employment, whose cases were reported as doubtful, that they must obtain certificates from the appointed expert before they could be considered eligible for employment. Whether the fee should be paid by the company or by the candidate would be a matter of arrangement between them.

The mode of examination which I would suggest, as falling within the capacity of the officers of the companies themselves, would be very simple. I would let them call upon each candidate rapidly to sort into two heaps twelve skeins of wool, six of which should be red and six green, both in gradations of colour, and to throw all the red into one heap and all the green into the other. Any normal sighted person would accomplish this sorting very quickly, and with absolute ease and certainty; and any candidate who did this should be considered as having passed in colour. Any candidate who rapidly made a wrong selection should be rejected without hesitation. Any candidate who sorted his wools slowly, and as a result of careful comparison, would at least have defective colour sense, and should be referred to experts to decide upon his exact condition. He would probably belong to the class of the incompletely colour-blind; whose condition is such that they can distinguish red from green in certain circumstances and at short distances, but not under all circumstances, nor at all distances. It would then be the duty of the expert to pronounce upon the degree of the defect, and it would be the duty of the railway authorities to decide whether that degree amounted to a disqualification in the course of the particular man; due regard being had to his capacities in other respects, or to his claims, from past service or other causes, upon the consideration of his employers.

The visibility of an object depends upon the size of the surface within the eye which is covered by its image; and this again upon the two elements of size and distance, which govern the dimensions

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The Nautical Department
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ions into which inquiry should be made, and conducted in the following manner. The ner is furnished with thirty cards, of which e white, five black, five blue, five red, five , and five yellow, the colours being all ted. Shuffling the cards, he withdraws one, now another, and, suddenly showing it candidate, asks what colour it is. Correct s are accepted as evidence of correct colour-; and the examination is carried further by s of coloured glass, held up between the per-xamined and a window. Now I think it quite ble that an intelligent man, trained, as the r-blind often are trained, to study slight dif-ces of luminosity, might conceal colour-blind-throughout such an examination. Assuming o be red-blind or green-blind, and these are st common forms, he would be in no danger he rest of the cards, and the very saturated d greens would present to him marked dif-s of luminosity. I think that a case of in-te colour-blindness, which might entail anger from incapacity to recognise colour at sufficient distances, might entirely escape ry. For naval purposes, the examination be confined, as in the railway services it to red and green alone; on account of the colours of signal flags; and I think it be rendered perfectly safe by the same which I have suggested for railways, a modified to meet the altered circumstances. xaminer should, I think, have his tests in with five or six shades of each colour, and ndidate should be required to sort them y into heaps.

s not the practice of the Board of Trade to certificates to colour-blind applicants, but o endorse the fact of colour-blindness upon rtificate. In this way the officer himself, and ployer, are alike warned of his defect, and, he may be engaged on account of his other ilities, neither he nor they will have any e for trusting to his power of discrimina-olour-signals. If the wool test were adopted service, I would suggest further that, as in ase of railways, the subjects of incomplete r-blindness should be tested by experts with nce to degree, and that this should be endorsed the certificate as well as the complete forms he affection. I trust, however, that the is not far distant when proper examinations g childhood will prevent persons from taking first step in callings for which they are festly unfit.

ave left myself very little time in which to of the influence of colour-blindness upon callings; and, in the few words which I can te to this part of the subject, I may mention it seems to be really an advantage to engravers, generally to all persons who produce illustra-in black and white, on account of the in-ed acuteness of perception of the variations ght and shade to which it appears to lead. any other callings it presents a serious impedi-to success. There was a clerk in a Govern-office in London whose desk was furnished three bottles, containing respectively, red, blue, black ink; and he only knew which was which lacing them before him in some definite order. as the pleasure of mischievous boys in the office, who had found out the clerk's defect, to change this order whenever his back was turned; and the result was that he used to bring to his superiors parti-coloured letters for signature. He was transferred to a department where it was his duty to tick off certain entries with black ink and others with red; and here he succeeded in producing a confusion which has hardly yet been disentangled, and which utimately led to his dismissal. Dr. Joy Jeffries tells me of a portrait painter in New Boston, so skilful in his drawing that he gets £100 or £200 for a portrait, but who has to employ somebody else to mark his reds and greens before he ventures to use them. He also mentions three brothers who are colour-blind. One of them was a carriage painter, and he had to have his paint-pot given him by somebody else before he could begin to work. Another was in a furniture store, and could not rise above a packer, in consequence of having tried to persuade an old lady to buy a red sofa to match with green chairs. The third was in a large dry goods store, but could do only menial work in consequence of his defect. Dr. Jeffries also tells me of a medical student, who was plucked in his examination on account of errors in discriminating the actions of chemical tests, which were afterwards discovered to be due to colour-blindness; and in his book on the subject he mentions the case of a post-office clerk in Prussia, who was found to be constantly wrong with his accounts about the stamps. But at length it was discovered that he was colour-blind, and could not distinguish red from green stamps, so that he was perpetually in error about his charges for those which he issued to purchasers. A volume might be written about the possible mistakes of the colour-blind, but it would not materially advance our knowledge for any practical purpose. The most remarkable are those committed, when two colour-blind persons reinforce each other. as in the case of the gentleman who went to match some red wools for his wife, and succeeded, by the luminosity of sample, as long as only the bundle of red wool was brought to him to select from. At last a time came when a colour-blind shopman brought him a bundle of green wools, and from this the two together selected their matches for the red with entire complacency.

In a large number of civilised countries, the facts which I have roughly brought together in these lectures have already induced steps to be taken by persons in authority to provide against the dangers of the situation. In England, as I have stated, the Board of Trade was early in the field, and, thanks to the powers committed to it, is able to afford protection to the mercantile marine without a special act of parliament being required. In Norway and Sweden, where railways are more under control than with us, similar arrangements have been made with regard to them. In various continental countries people are becoming more and more attentive to the subject; but the lead has been taked in the United States. Massachusetts was the first to legislate; and a stringent law has quite recently been passed in Connecticut, which requires the whole *personnel* of the railways of the State to be examined for colour-vision every two years by a "competent person;" a phrase which, if it were used in England, wonld furnish much employment to the gentlemen of the long robe.

would compel all railway companies to have their servants tested for colour-vision by scientific methods; although it might fairly be left to the companies themselves to employ the colour-blind, if they chose to do so, in any capacity in which their defect was not a source of danger. But colour-blindness should at least be made known; and there should be no possibility of lives and property being sacrificed through ignorance of its existence.

MISCELLANEOUS.

CHINA GRASS DRESSING MACHINES.

By C. G. Warnford Lock.

I have just received from the Agricultural Department of the Indian Government a report on the trials of the China grass machines, which was intended for incorporation in the article on "Fibrous Substances" in Spons' "Encyclopædia." It has arrived too late for this purpose, but will probably interest readers of the *Journal*.

The seven competing processes may be thus briefly described :—

1. J. P. Vander Ploeg's appliances consisted of a crushing and a scutching machine; he cleaned the fibre finally by boiling it in a prepared liquor.

2. J. Nagoua used a combined crushing and scutching machine, adaptable to both operations.

3. R. H. Collyer boiled the stems first in water with a very little soda, then passed them through a machine which broke them up, and again through the same to clean them. He had also a smaller manual machine, costing only £60, but unsuitable for a regular factory.

4. Laberie and Berthet's machine crushed the stems, which were kept constantly wetted; the fibre was then steeped in a bleaching liquor and an alkaline liquor.

5. J. Cameron abandoned the machines described in his specification, and brought a hand implement.

6. C. F. Amery broke the stems in a crushing

upon native methods current in I
applied in many of the Indian ga
fibre; it can be employed upon gr
long stems, but would hardly be s
tation where many acres had to
Therefore the recommendations a
to Nagoua and Vander Ploeg, and

The committee conclude that, fr
put upon the samples produced a
does not seem probable that the
yet be able to compete with the
plant can be grown in the moist
of parts of Burma, Upper Assa
northern Bengal, with only the
for a rather superior crop, it r
commercially. Until this has
proved, and a real need has arise
of treatment, the Government
renewing the offer of prizes; an
with maintaining some acres of t
vation, for supplying roots to int

Thus, even after much experien
the matter, and with every ince
machinists of Europe are comp
complete inability to match the
Chinese. It may be incidentally
the seven competitors no less tha
their proposed plans, these four inc
This fact seems to indicate an
acquaintance with the material
amounts to an acknowledgment
that they had been working in
This may probably help to accoun
ness. On the other hand, of the
(the Frenchmen) have presumal
experiment upon the plant which
in the south of France, and they
well known among Continenta
The moral of this is the necessit
ment on the part of English mach

CINCHONA CULTIVATIO

Surgeon-Major George King,
the Royal Botanical Garden, Calc

bark trees and trees of the still unnamed hybrid y. It has not been deemed necessary to increase mber of *Succirubra* trees, from which the cinchona uge is manufactured. There are now more than millions of these trees on the two plantations of ;poo and Sittong, and this is considered quite ent to provide red bark for a much larger consump- f the febrifuge than there is any reason imme- y to anticipate. Endeavours have therefore been ed to increasing the stock of quinine-producing to meet the demand for sulphate of quinine in the tals and different departments of the Government e. There are two descriptions of these trees on antations, the supposed hybrid variety and the *ya*. Of the former, which yields a bark rich in ie, 90,320 plants were put out during the year, 0 at Mungpoo, and 5,000 at Sittong, and the number now on the plantations is 199,898. al attention has been devoted to the propoga- of the *Ledgeriana* variety of *Calisaya*, which is ially rich in quinine, and 99,415 trees were planted Mungpoo. At Sittong 6,000 *Calisaya* trees were ut. There is a large nursery stock of *Ledgerianas*, he permanent plantation of this valuable variety robably be largely increased during the current

The propagation of the species which yields the agena or Columbian bark has been retarded by the s of the "thrip" pest. This species was only luced in January, 1880, when the late Mr. Bier- brought out four plants of it. There are now 60 l plants and 90 partially rooted cuttings, and every will be made to increase the stock.

total number of trees of all kinds planted out in wo plantations of Mungpoo and Sittong is ,720, this amount being made up of the following :—*C. succirubra* (red), 4,034,535; *C. calisaya* w), 412,695; unnamed variety, 199,898; other , 30,592.

produce of the plantations of the year was 15 lbs. of dry bark, against 361,590 lbs. in 1879-80, 61,659 lbs. in 1878-79.

arge number of trees of the interior kinds of *ya* were uprooted during the year. This species les several varieties, many of which, as Dr. King "produce barks which are essentially druggists' , being well suited for preparations, such as decoc- and tinctures, but being unsuited for the manu- e of febrifuge, and containing too little quinine worked profitably as sources of the pure sulphate t alkaloid." There being thus no way of dispos- cally of a considerable quantity of yellow bark, a nment was sent to London for sale. The oppor- was taken to send a small quantity of good *riana* bark to get some idea of its commercial value. ing remarks that yellow bark of any kind from had never before been offered in the London t, and that, indeed, except at Mungpoo, it is not anywhere in British India. The result was con- d most satisfactory. *Ledgeriana* bark sold for 0d. per pound, and the inferior bark also fetched good prices.

introduction of the Java plan of shaving the of living trees to the height of from 8 ft. to 10 ft. the ground was an interesting feature in the tions of the year. The results have been favour- as under this plan the bark renews perfectly. King proposes to test by analysis whether the re- l bark is as rich in medicinal alkaloids as the al bark. But the Dutch plan of grafting *Ledgeriana* *ccirubra* stocks, which was also tried during the was not attended with success. A further trial, ver, will be made.

general condition of the plantations is satisfactory. rowth of *Succirubra* in Sittong is not as flourishing might be; but *Ledgeriana* and the hybrid variety riving well. It is found that these two varieties better on land with a southern exposure than on land that looks to the north. It will thus be possible to utilise a considerable area which has hitherto been con- sidered unsuitable for any kind of cinchona.

The total outturn of the febrifuge factory during the year was 9,296 lbs. The cost of manufacture, including the cost of the bark used, was Rs. 85,921 6a. 3p., and the average cost per pound rather less than last year. During the year 8,653 lbs. 13 oz. of febrifuge was dis- posed of as follows:—

	lbs.	oz.
To medical depôt, Calcutta........	3,000	0
" " Bombay........	2,000	0
" " Madras........	500	0
Sold to the public	3,150	11
Given as samples, &c.	3	2
Total........	8,653	13

The sales to the public are stated to be steadily in- creasing, and the febrigage is said to be daily increasing in reputation as a thoroughly good cure for fever.

The financial results of the operations during the year were very satisfactory. The receipts from the sale of febrifuge and seed and plants, and the sale of bark in London, amounted to Rs. 1,79,657 2a. 11p.

The actual profit exhibited on the year's working was 80,290 rupees, equal to 8 per cent. on the capital of the plantation, while the value of the stock in hand at cost price was 94,294 rupees. This, however, does not represent the whole of the gain of the year. The price of quinine was very high, and the cost of 5,550 lbs., which would have been used by Government had the febrifuge not been available, would have been, at the lowest estimate, 5,50,000 rupees. The cost of the febri- fuge used was only 90,880. There was thus a clear saving of 4½ lakhs of rupees. The savings effected by similar substitutions of febrifuge for quinine in previous years amounted to 11¾ lakhs. The total saving there- fore has already amonnted to more than 16 lakhs of rupees.

The expenditure for the year amounted to Rs. 71,705 10a. 4p., being between one and two thousand rupees less than the budget estimate and allotment. In making out the accounts, care is taken to keep the expenditure of each plantation distinct. Dr. King observes that "the account of the Sittong plantation ought, when it is completed, to be of much interest to Cinchona planters, as they will show at how cheap a rate a plantation can be put out, when the price of experience does not form, as it so often does in new enterprises, a very heavy item in the capital expenditure."

ANTIMONY DEPOSITS IN SONORA.

In the recesses of a short range of mountains, the Sierra del Alamo Muerto, which skirts the eastern shore of the Gulf of California, at about thirty miles from the gulf, and fifty miles from El Altar, are several silver ledges, which have been worked from time immemorial by the Mexicans, and have recently passed into American hands. The most notable, says a writer in the *American Mail*, is the San Felix, which has been burrowed into to a depth of 700 feet on the incline. On the northern flank of the range an area of consider- able extent is strewn with quartz and a heavy yellow mineral. This is said to have been long ago amalgamated for silver, but to have yielded so base an amalgam (per- haps from the presence of a little native antimony) as to have been rejected as a silver ore; and its true character seems to have been either overlooked or mistaken until recently. Samples were sent to England, where the value of the mineral as an ore of pure oxide of antimony was at once recognised. Shortly after that Professor Cox, late of the Indiana survey, made arrangements with the owners to ship the ore for treatment to works he has since erected in Oakland, Cal. There appear to be three systems of veins within an area of about four

permeate the mass of the ore, and seems to exist as chloride and iodide. The silver contents are said to be 125 dollars per ton, which is considered to be a very moderate estimate, as on the pile at the mouth of the Santa Margarita shaft it was difficult to find a lump whose joints were not more or less stained with silver, while many were thickly covered. Since then work has gone on actively on all three groups of lodes. On the first the ore bodies have been developed to a depth of 72 feet, on the second to a depth of 70 feet, and on the third to a depth of 118 feet, with no signs as yet of a change in the character of the ore or average size of the ore bodies, which, however, have never exhibited great uniformity in width. Two schooner loads have lately been shipped, and it is estimated that 5,000 tons of ore have been exposed by the superficial explorations recently made. A reference to Mr. Cox's papers on the native oxide of antimony, read before the American Association, will be found in this *Journal*, vol. xxviii., p. 874.

NOTES ON BOOKS.

Lathe-work. By Paul N. Hasluck. London: Crosby Lockwood & Co., 1881.

There is no doubt that many interested in mechanics, especially as amateurs, have found the want of a good practical treatise on the amateur's tool *par excellence*, the lathe. "Holtzapffel" is too costly for everybody, and, besides, the original work stopped short before it reached the lathe. The introductory matter extended itself to such a length that the author had not time before his death to complete the work he had designed. Many other writers have tried to fill the gap, but, without casting any reflection on their efforts, it must be allowed that we are still without such a work as "Mechanical Manipulation" would have been had the elder Holtzapffel lived to finish his work. Of these writers, Mr. Hasluck is the latest, and his book will certainly bear comparison with those of any of his rivals. He seems to owe little to his predecessors, for his book looks like the result of original work and experience, and as such it will doubtless recommend

entirely, wasted.

GENERAL N

London Sanitary Protection A general meeting of this association w of Arts' Room on Tuesday, the 25 when Professor Huxley will preside. done during the last nine months, si of Professor Fleeming Jenkin's pap Arts on January 12th last, will be gi members of the Society of Arts ar meeting.

Effects of Light on Vegetatio been making experiments lately on that the germination of certain agric meadow grass (*poa*) is much more fa heat. An experiment made with t each, of *Poa nemoralis*, showed that cent. in light, and 8 per cent. in da were made with *Poa pratensis*, sho minating in light, and 7 per cent. i being a very variable force, experim with gas light, and with the same favours the germination of certain and that these germinate either not in darkness. The fact was verified whole series of seeds, such as *Festuca*, &c. In the case of seeds that germi such as clover, beans, or peas, Herr S is probably not advantageous.

Electric Light Engines.—Mess show seven stationary engines a Exhibition, varying in size from 10 t supply the power for the dynamo-e Brush Electric Light Company, and steady action, owing to the adoption "governor." The 40-horse power e arc lights; and, after careful exper the variation from the nominal spe revolution during the evening's wor in addition to this power of self-reg have adopted the expedient of maki keep each other in check. Three e one length of shafting, the object

NAL OF THE SOCIETY OF ARTS.

No. 1,510. Vol. XXIX.

FRIDAY, OCTOBER 28, 1881.

nications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

THE JOURNAL.

ı the commencement of the new volume on ıber 18, certain alterations will be made in ıe used in the *Journal*, which it is hoped will re its appearance. No change will be made size of the pages.

he regulations of the Post-office now permit ıpers to be stitched without incurring addi- charge for postage, it is intended in future ıh the *Journal*. This alteration, also, will ence with the new volume.

ARRANGEMENTS FOR THE SESSION.

arrangements for the one hundred and ,-eighth session of the Society have now ıade by the Council, and full particulars will ıted in the next number of the *Journal*.

first meeting will be held on the 16th ıber, when the opening address will be de- . by Sir F. J. Bramwell, F.R.S, Chairman Council. Previous to Christmas, there will : ordinary meetings in addition to the open- eting. Candidates proposed for election as rs, are privileged to attend the opening g.

e will be four courses of Cantor Lectures the session. The first course, on "Some Industrial uses of the Calcium Compounds," mas Bolas, F.C.S., will be delivered before ıas.

wo Juvenile Lectures at Christmas will be H. Preece, F.R.S., on "Recent Wonders of city." Announcement of the arrangements se Lectures will be made in due course.

PATENT LAW.

evening of Wednesday, November 30, will ɔted to a discussion on the Society of Arts' Bill, which will be continued on such other s as may be found convenient. The dis- cussion will be opened by Sir Frederick Bramwell, F.R.S., Chairman of the Council.

The Secretary will be glad to furnish tickets for the meeting to persons interested in the subject of Patent Law who are not members of the Society.

OWEN JONES PRIZES FOR FURNITURE DESIGNS.

The Council are Trustees of the sum of £400, presented to them by the Owen Jones Memorial Committee, being the balance of the subscriptions to that fund, upon trust to expend the interest thereof in prizes to "Students of the Schools of Art who in annual competition produce the best Designs for Household Furniture, Carpets, Wall-papers and Hangings, Damask, Chintzes, &c., regulated by the principles laid down by Owen Jones;" the prizes to "consist of a bound copy of Owen Jones's 'Principles of Design,' a Bronze Medal, and such sums of money as the fund admits of."

The prizes will be awarded on the results of the Annual Competition of the Science and Art Department. Competing designs must be marked "In competition for the Owen Jones Prizes."

The next award will be made in 1882, when six prizes are offered for competition, each prize to consist of a bound copy of Owen Jones's "Principles of Design," and the Society's Bronze Medal.

PROCEEDINGS OF THE SOCIETY.

EXHIBITION OF WORKS OF ART APPLIED TO FURNITURE, 1881.

The following Report of the judges appointed to recommend awards of silver and bronze medals, offered by the Society of Arts to the Designers and Art Workmen whose work was exhibited in the Exhibition of Works of Art applied to Furniture, held in 1881, at the Royal Albert-hall, has been received by the Council, and been approved by them.

1. The collection of works of Art included many branches of artistic handicraft, such as carving and inlaying in wood, ivory, &c., cabinet work and fine joinery, painting on various materials like wood, glass, and pottery, glass cutting, the process known as *pâte sur pâte*, beating and chasing metals like silver and brass, wrought-iron work, modelled and glazed stoneware, and decorative needlework. The arrangement of the objects had been undertaken by the various exhibiting firms. A definite space had been assigned to each firm, who decorated it with hangings or with painted and gilt moulded work, or wood panelling, &c., and then disposed within it the various objects of furniture, &c. We were much pleased with the general good

the medallions, merit the distinction of a Bronze Medal. In this Bay a tray and set of tea things, in a dark olive-green body, ornamented with applications of well-depicted forms in white paste *(pâte sur pâte)*, exhibited by Messrs. Mintons, and designed and executed by Mons. Solon, we specially commend as worthy of a Silver Medal.

3. The decoration of the side of a room, exhibited by Messrs. Morant, Boyd, and Blanford, remarkable for the excellence and finish of the work, was based upon a scheme good in its proportions, and the blending of the delicate tones of colour adopted, with those of the damask panels, and the details of the ornamental forms used, redound to the good taste of the designer, Mr. V. Barnard. Messrs. Morant, Boyd, and Blanford also exhibit a satin wood cabinet, and we consider that Mr. H. Reich, who inlaid the frieze of interlacing garlands upon the front of the drawer and the central ornament of the flap should be rewarded with a Bronze Medal.

4. Near Bay No. 2 hung three red lustre plates, the work of Mr. W. de Morgan, to whom a Silver Medal should be given for suitability of design to the materials employed, as well as for the fine tones of colour and lustre obtained.

5. In Messrs. Jackson and Graham's cabinet and chimney-piece, of a so-called Oriental Greek character, extraordinarily delicate and perfectly fitting marquetry work, and very finished cabinet-makers' work, attracted attention. A Bronze Medal is due to Mr. A. Reich, the marquetry worker, and a Bronze Medal to Mr. A. Baldwin, cabinet-maker; to Mr. Marchant, who is understood to have assisted in the cabinet work, we award one of the Society's Certificates. Beneath the chimney-piece in rosewood, with plaques of inlay of ivory, ebony, and mother-o'-pearl, designed by Mr. Allwright, was a wrought iron grate, of simple design, in good taste, made by Mr. Sayer, a member of the firm of Messrs. Feetham and Co., who exhibited other grates and fire-irons of good pattern and workmanship. A piece of embroidery, designed by Mrs. Alfred

piece showed good cabinet-
designer of these pieces is M
select for an award of a Bron
for his design for a white
fittings. Some extraordina
cutting and engraving, by
has produced a very remark
"Portland vase," probably
glass-cutting of modern tim
the "Milton vase," design
of the Red-house Glass-w
by Mr. Pargeter. To the
Northwood, we award a Silv

9. Messrs. Wright and
several excellent examples
English 18th century style
Chippendale, Adam, and
work, enamelled and decorate
by Pergolesi. Awards of
made to Mr. Thomas Hinto
man, and to Mr. Victor
worker, and of Certificate
Bryne, Charles Humphreys
cabinet-makers, by whom
of these works were pr
and gilt mirror frames and
of the 18th century Englis
French periods, especially
sideboard, were noted for
the carving being done by M

10. The modelling of the
by many hands, in a deep
piece and cabinet exhibited
and Lock, was particularly
a Silver Medal to Mr. Webb
and for many other speci
design for metal sconces was
ness in arrangement of conv
grouped, and modelled wi
relief and harmony in flow
worker who wrought this
Singer, to whom we award

-le of design, with interlacements of rod -ten leaves of plate iron. The figures panels, of deep modelled relief in terra-ed and executed by Mr. G. Tinworth, expressive action, and we consider -tificate should be awarded to this award a second Certificate to Mr. h, the designer of the large flattened, wl, executed in stoneware, and shown Doulton; and a Certificate to Mr. ars, for his careful and clean painting rome on two tiles, called respectively Companion" and "An Odd Chicken." to commend the skill displayed in two -carved birds in lime-wood, the work of rry. Two panels of painted glass, suitable coration of a house or hall, representing id "Science," appeared to us to show a preciation of the application of coloured glass, without detracting from its utility low through which light has to pass.

Bay No. 9, containing articles exhibited rs. Gregory and Co., the reproduction of an lish arm-chair, enriched with carved and rails, and a little tea-table, were highly in workmanship, and commendable for the ss of their construction. We award a Bronze to Mr. W. P. Collins, the designer of these . To the designer, Mr. T. W. Hay, of the hanging, for the drawing and arrangement ils, as well as for good harmony of colour, pose to award a Certificate.

The well-proportioned framework or walnut ing, for the side of dining-room or hall, by Messrs. Johnstone, Jeanes and Co., in No. 11, was excellent in design, but, in our n, the effect would have been better if simple panelling instead of tapestry had been used. vas it produced the impression of an open which had been filled up, rather than of a

The carving of the students of the School of Carving, South Kensington Museum, was rious; and the pilaster executed by Miss r Rowe, of this school, showed good feeling w of line and the modelling of surfaces. It e well to mention here that a principal this school is to cultivate the production d-carving in a broad style, and at a cheap imilar to that used so largely for decorative es in the 18th century in this country. The of this school are not, therefore, intended pete with more expensive and more highly d wood-carvings.

We award a Silver Medal to Mr. R. Gleeson, suitable and graceful fan-mounts, which he signed and executed, especially that of mounted with Mechlin lace. The inlaid na wood table, the work of Mr. Thomas gained the distinction of a Bronze Medal, beauty of the marquetry work.

In concluding our report upon this Exhibition, of opinion that annual Exhibitions, at which own various classes of Fine Art Applied to ry, such as those represented at the present tion, might be usefully supplemented were ers for all sorts of handicrafts and manu-s to be encouraged to submit drawings and s of designs which *have actually been out.* A section was allotted for such drawings at the Paris Exhibition of 1878; and, in our opinion, much useful instruction and information might be gained from such an annual display of designs to the benefit of producers and consumers.

George Godwin (F.R.S.).
Montague Guest (M.P.).
Edward J. Poynter (R.A.).
Alan S. Cole (Hon. Secretary).

5th August, 1881.

The Viscount Hardinge wrote to express his regret at being prevented from attending the meeting.

LIST OF AWARDS.

Silver Medals.

Mons. Solon, for olive green tea service, *pâte sur pâte* (Messrs. Minton).
Mr. de Morgan, lustre plates.
Mr. Webb, modeller and designer (Messrs. Collinson and Lock).
Mr. R. Gleeson, for carved fan mounts.
Mr. Northwood, for glass cutting and engraving (Mr. Pargeter).

Bronze Medals.

Mr. H. Scholz, for painted furniture (Messrs. J. G. Crace and Son).
Mr. Vernon Barnard, designer of side of room (Messrs. Morant, Boyd, and Blanford).
Mr. J. R. Randal, furniture designs and design for fender (Messrs. Howard and Co.).
Mr. Albert Reich, marquetry worker (Messrs. Jackson and Graham).
Mr. H. Reich, marquetry worker of cabinet (Messrs. Morant, Boyd, and Blanford).
Mr. William Allwright, designer of rosewood chimney-piece, inlaid with ivory, ebony, mother-o'-pearl (Messrs. Jackson and Graham).
Mr. Baldwin, cabinet-maker (Messrs. Jackson and Graham).
Mr. T. Hinton, foreman cabinet-maker (Messrs. Wright and Mansfield).
Mr. Victor Reich, marquetry worker (Messrs. Wright and Mansfield).
Mr. Singer, for beaten brass-work (Messrs. Collinson and Lock).
Mr. G. Price, for beaten oxydised silver frame (Messrs. Collinson and Lock).
Mr. W. P. Collins, designs for furniture (Messrs. Gregory and Co.).
Mr. T. Jacob, for marquetry top to table.

Certificates.

Mr. Marchant, cabinet maker (Messrs. Jackson and Graham).
Mr. C. Humphreys, cabinet-maker (Messrs. Wright and Mansfield).
Mr. T. Miller ,, ,,
Mr. S. Bryne ,, ,,
Mr. M. Anderson, carver (Messrs. Gillows).
Mr. T. W. Hay, designer of woven silken fabric for room decoration (Messrs. Gregory and Co.).
Mr. G. Tinworth, terra-cotta panels.
Mr. G. Tinworth, designer and modeller of flattened round bowl, shown by Messrs. Doulton.
Mr. Edward Sears, for painted tiles.
Miss Eleanor Rowe, for carved wood pilaster.
Mr. W. Perry, for carving in wood.
Mr. Sidney Phelps, wrought-iron work.
Mr. W. C. Codman, designer of panelling (Messrs. Johnstone and Jeanes).

MEDALS OF THE SOCIETY OF ARTS.

The Society of Arts grew out of a suggestion made by William Shipley, a drawing master of Northampton, and brother of Jonathan Shipley, a well-known Bishop of St. Asaph. Shipley issued on June 8th, 1753, "Proposals for raising by subscription a fund to be distributed in premiums for the promoting of improvements in the Liberal Arts and Sciences, Manufactures, &c;" and in December of the same year he published "a scheme for putting the proposals into execution." The Society was formed in 1754, at a meeting held on 22nd of March at Rawthmell's coffee-house in Henrietta-street, Covent-garden. Premiums were at once offered for the discovery of cobalt and the growth of madder in this country, and for proficiency in drawing. With these offers the Society commenced its prosperous career. A proposal to give medals "on some occasions instead of money" was considered at the meeting of April 30th, 1755, but the matter was postponed as no action could be taken that year. Henry Baker, F.R.S., read a paper on March, 24th, 1756, proposing the distribution of medals as honorary premiums, in which he said—

"It is therefore proposed that a dye be made for striking medals of gold, silver, and copper (with proper devices), to be occasionally bestowed by the Society as a token of honour and esteem on such as shall practice or produce some new manufacture or discovery that may employ many hands, some considerable improvement of public utility, or some valuable branch of commerce in one or the other metal, according to the nature and consequence of the improvement or discovery; which medals in gold shall be of £5 value, and proportionately in silver and copper, though, in all of them, the honour of being thus distinguished is the principal object of regard."

This paper was referred to a committee for consideration on March 31st. The committee reported on April 7th that they were of opinion that the giving of medals would be of utility, and they suggested that a committee should be appointed to consider a proper device. Subsequently Mr. Baker submitted a sketch of a design, as did Nicholas Crisp and Mr. Ralph. Hogarth, Henry Cheere, and Nicholas Highmore were upon the medal committee, who agreed upon a device, and afterwards James Stuart, William Chambers, and Thomas Hollis, were added to the committee. After the design had been chased upon gold plates, and the order given for the dies to be cut, a difficulty arose. It was decided on March 23, 1757, that the value of the medal should not exceed ten guineas, but when specimens of the selected design were produced it was found that the die could not be carried out completely if less than 15 guineas' worth of gold was used. This was considered too much, and the report of the committee was referred back to them, with instructions to obtain a new device which should only need gold to the amount of five guineas. If, however, the device in hand could be executed for the proposed five guineas, this was to be preferred. On May, 24th, 1758, Mr. Yeo produced two gold medals, struck from the die which he had cast, the value of one being ten guineas, that of the other, £8 10s. This was not considered satisfactory, and the committee to whom the matter was referred declined to make a report. The general meeting of the S discussed the point on June 7, and resolved:

"That it is the opinion of this Society that medal does not, both in execution and answer the interest and expectation of the Soci

It was further resolved that dies and pu should be cut for a new medal, according designs of Mr. Stuart, the value in gold n less than five, nor to exceed eight guineas, p to a former resolution. Mr. Stuart was no to appoint his own artist, and he chose Pingo, the famous die sinker, who agree dies and puncheons for eighty guineas. T was quite satisfactory, but in Novembe found that he could not buy gold and silver a licence, and Mr. Pinchbeck (a rather name, considering the metal associated name) was desired to furnish Mr. Pingo w and silver for the purpose. At last the Soc tained what they had so long been strivin thoroughly good medal, at a reasonable co November 29, the thanks of the Societ unanimously given to Mr. Stuart, and a gol was ordered to be presented to him, for t care and trouble he had taken in this matt December 6, it was ordered:—

"That the inscriptions on the first gold meda is to be presented to Lord Viscount Folkeston dent of this Society, be forthwith engraved, as (in pursuance of the resolution of the 24th last):—On the reverse, without the wreath To Jacob, Viscount Folkestone, Preside within the wreath of olive, For Eminent Servi

Inscriptions for other gold medals were ord the same meeting. To Lord Romney, for e services; to Lady Augusta Greville, for dr 1757; to the Duke of Beaufort, Philip C Webb, F.R.S., and John Berney—all for acorns, 1757; and to James Stuart, paint architect, "for designing this medal." T verse of the medal is shown in the annexed

First Medal of the Society.

There was much discussion in the Soci pecting the inscription on the obverse of this Thus in May, 1857, it was decided that the should be "Arts and Commerce Promot stead of "Arts, Manufactures, and Comme moted." In November it was changed to " for Promoting Arts and Commerce," and l the inscription as first proposed was adopt the earlier draft the date of institution was s

;3, but afterwards it was fixed for the year

; medal was largely used for nearly half a ;y, but in 1801, James Barry took occasion in oount of his additions to the pictures in the room, to suggest an improvement in the ı. He wrote:—

r. Barry begs leave to add, from a letter read by the Society, Ooctober 25th, 1801, that in con- ıce of the application for designs for a new die for medal, he stated his intention of introducing a cation of their former design, which he thought answer their intended purpose. The more the t matter of that design is considered, the more ust admire and respect the sterling good sense and ty consideration of the original founders of the r. Nothing can be more happily imagined than ıa consisting of Britannia aided by Minerva and ry, the classical tutelary deities of Arts, Manu- es, and Commerce; and this old device, like many good old usages, cannot be amended by any change substratum. It requires nothing more in its ı, and will most happily coalesce and accommodate ll the acquisitions and improvements of the most ed and refined culture. For this purpose a little *goût* and character in the figures is all that is ıry, enlarging them so as to fill the space with lignity, and taking away from their individual ed appearance by the little graces and arts of a mproved composition. And as there is always a rable dignity and consequence attached to mag- which is one of the constituents of sublimity, his sted alterations would come to this—to substitute d of the little entire figures of Minerva and ıry, only two large heads of those deities, and he omit the head of Britannia altogether, and by a h of the shamrock, rose, and thistle, totally rising the edge of the medal, playing in and out in a 'ul gustoso manner, he would represent the present y United Kingdom of Great Britain and Ireland, ı felicity, at least, equal to the owl, the horse's or the dolphin on the Athenian, Punice, or Sicilian ,*

s full description of Barry's views is interest- ıs showing how completely they were carried ı the new medal. In 1802, a totally different n was discussed. Application was made to Marchant, Associate of the Royal Academy, ;em engraver, to prepare a die, and the Com- ıe of Polite Arts recommended "The Society ı personified by a female, seated, having in hand a wreath of laurel, and with the directing attention to the statues of rva, Mercury, and Ceres, the ancient deities ling over the Liberal arts—commerce and ılture—the immediate objects of the Society." ıbverse of the medal to be the head of the lent, with the date of his election, and the of the gold to be twelve guineas. Mr. hant, into whose hands the work was placed, ırs to have been very dilatory, and after many ries it was decided, in April, 1805, to order him ıspend proceedings with the dies until he hears the Society." The Committee of Polite Arts declared that it was expedient to resume the :ration as to the design *ab initio*; and they ımended the Society "That Messrs. Papworth, nan, Howard, Barry, and Tresham be sever- applied to, professionally, to furnish rough ıes and designs for the intended medal."

* Transactions—Vol. 19, pp. xxxvi—xxxix.

At a meeting of the Society, on the 4th December, 1805, a report of the Committee, recommending that Mr. Flaxman be desired to furnish a design, on the principle suggested by Mr. Barry, was read, when Barry made a motion to the effect that the report should be recommitted, but his motion was not agreed to. The next meeting, on the 11th of December, was apparently a stormy one, for a series of motions were brought forward, most of which were "disagreed to." At last, Mr. Wakefield made the definite proposition that "the name of Flaxman be erased, and that of Barry inserted;" but this did not find favour with the meeting, and eventually the original resolution of the committee was agreed to. Barry died in the following year, and then there was no obstacle to the completion of Flaxman's medal. Mr. Pidgeon prepared the dies, and in November, 1806, Flaxman expressed himself as highly pleased with the excellence of the execution. The Society were so

Medal designed by Flaxman.

pleased with the new medal, that they desired to have an engraving of it for publication in the Transactions. Flaxman proposed that his sister-in-law, Miss Denman, should make the drawing,

Another form of the Minerva medal.

and that the famous Anker Smith should engrave it. The engraving thus produced forms a frontispiece to the 25th volume of the Transactions. Among the medals presented in 1807 were these two:—

J. Flaxman, Esq., R.A., Buckingham-place, for

the design of the Society's new medal, modelled and presented by him—the first gold medal.

Miss Maria Denman, for her drawing of the new medal, the silver medal.

In 1818, it was found that the die for the Minerva medal was worn out, and Mr. Wyon offered to make a new one from Flaxman's original model, and to present it, in consideration of the liberal treatment he had always received from the Society. The thanks of the Society were voted to Wyon "for his very handsome offer" at the meeting on June 10th.

A case of fraud in the use of one of the medals came under the notice of the Society in the year 1813, which was summarily dealt with. The Minerva medal was given to an inventor "for his safe and economical fire of wood shavings," and the man engraved a representation of the medal on his business card, with the statement that the Society had presented it to him "for his invention of a superior method of preparing his materials for the manufacturing of pianofortes, organs, and other musical instruments. being called upon for an explanation, the pi maker tried unsuccessfully to excuse his and, on demand, he gave up the copper his cards. It was resolved by the Society should be destroyed, and all impressions burnt, with the exception of two to be p the minutes. At the meeting of May 26th

"The Society deeming it proper to have the tickets destroyed without loss of time, an c given from the chair to that purpose, and t burnt in the presence of the members."

Honorary Pallet.

For a few years after the formation of th the only honorary reward was Stuart's me about the year 1766 it was thought expe adopt some honorary premium in place of p rewards for such successful candidates in th ent Sections (more particularly that of Pol who were under age. At a meeting of th

Obverse of Pallet.

Reverse of Pallet.

mittee of Polite Arts on January 28, 1766, it was resolved :—

"That these honorary premiums shall be pieces of wrought silver-plate, useful in, or allusive to, the particular art or branch of art in which the candidate claims (as drawing boxes, emblematical pallets, &c.), bearing an inscription exhibiting the name and age of the candidate, and the class and degree of premiums, &c., for which the same is given."

It was subsequently resolved that the pallet should be of an oval figure, 2¼ inches by 2, of the thickness of half-a crown. On March 21, two drawings which had been presented were considered, and one of them chosen. The die was to cost twenty guineas, and Mr. Johnson was desired to execute it.

There was a great silver pallet and a small one, and also in a few cases a gold pallet was awarded. The first award of the silver pallet was in 1767.

Isis Medal.

The Society has always been greatly interested in the improvement of the art of die-sinking, and at various times has offered premiums fo purpose. In 1809, Mr. T. Wyon, Jun., ap as a claimant for one of these, and produc

Isis Medal.

dies for a medal of Isis, which was highly ap and in the list of awards for the year 1810 the following entry :—

› Mr. ›T. Wyon, Jun., John-street, Blackfriars' nedal die engraving of a beautiful head of Isis, troness of the arts, the gold medal."

a meeting of the Society on April 4th, 1811, s resolved that this medal should be subed for the greater silver pallet, as a reward in epartment of Polite Arts. But at a subnt meeting it was agreed that the change l be made at the option of the candidates, herefore we find in the lists of awards for hat both pallets and Isis medals were given. on, the Isis medal became the favourite l of the Society, and was largely given in the is classes up to quite a late period.

CERES MEDAL.

1813, the Society's gold medal was given to 'illiam Wyon, of Birmingham, for a medal die ving of the head of Ceres; and at the meeting

Ceres Medal.

ie 2nd of this same year, the advisability of asing this medal for the purpose of award in partment of agriculture was considered. In gold and silver Ceres medals were awarded iprovements in agriculture.

VULCAN MEDAL.

1818, Mr. Mills produced a medal die of the of Vulcan, which was approved by the Society,

Vulcan Medal.

agreed that it should be purchased, and used second medal for the department of mechanics, ded the cost did not exceed twenty guineas, im paid for the Isis medal. Gold and silver in medals were given for the first time for ovements in mechanics in the year 1820.

SOCIETY'S MEDAL.

1849, the dies of the Minerva medal were l to be worn out, and it therefore became necessary to take some steps for the preparation of a new one. Mr. (now Sir Henry) Cole suggested "That it would be desirable, if possible, to obtain permission to use the H.R.H. Prince Albert's medal dies for the Society, such dies being portraits of His Royal Highness, the Society's President." And he reported to the Council in April of that year that he had been informed by Colonel Phipps that His Royal Highness approved of the suggestion. In August, 1849, it was resolved by the Council—

"That instructions be given to Mr. Wyon to proceed forthwith in the preparation of the new larger die, with an impression of the head of H.R.H. Prince Albert, presented by His Royal Highness."

Society's Medal 1849-1861.

At the election of His Royal Highness the Prince of Wales to the Presidentship, in 1863, his head was placed upon the obverse of the medal. At the same time the reverse was re-engraved; the wreath and inscription remained the same, but the engraving was bolder, and more artistic than that on the old medal.

ALBERT MEDAL.

The highest honour in the gift of the Society is the Albert medal, which was founded in memory of H.R.H. the Prince Consort, who was for eighteen years President of the Society. On the 4th February, 1863, the Council resolved:—

"That a gold medal, to be called the Albert medal, be provided by the Society, to be awarded by the Council not oftener than once a year, for distinguished merit in promoting Arts, Manufactures, or Commerce."

It was subsequently resolved that Mr. Leonard Wyon be requested to furnish the model for a head of the Prince at a late period of his life, the inscription to be "Albert, Prince Consort." It was decided that the reverse should be illustrative of Arts, Manufactures, and Commerce, and that several well-known artists should be invited to furnish designs. Ultimately, Mr. Leonard Wyon produced a design, which was accepted, and he then proceeded to prepare the dies. The first award of the Albert medal was in 1863, to Sir Rowland Hill: "For his great services to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have extended over the civilised world."

Albert Medal.

Society's Medal from 1863 to the present time.

MISCELLANEOUS.

WHEAT CROP OF 1881.

The following calculations on this subject by Mr. J. B. Lawes, F.R.S., of Rothamsted are taken from the *Gardener's Chronicle*:—

"The seven seasons ending with 1881 have been more disastrous to British agriculture than any seven consecutive years of which we have a record. Those who hold the opinion that the fluctuations of the weather occur in definite cycles, will have some difficulty in finding a parallel to the period of the last seven years, without going back to very remote records. The change in the relative proportions of home-produced and imported wheat which has taken place during the last few years has entirely altered the character of the trade. In 1868-9, two-thirds of the total bread consumed was the produce of home-grown wheat. A few years later the requirements of the country were met by one-half of home-grown and one-half of foreign wheat. But the harvest of 1879 scarcely supplied one loaf in four required, that of 1880 only one in three, and that of 1881 will also supply only about one loaf in three required. We cannot ignore the fact that, in consequence of t[illegible] great changes, the question of a good or bad wh[illegible] crop, however important it may be to the landow[illegible] or the cultivator, is no longer of the same import[illegible] to the nation at large as it was formerly. Ano[illegible] point worthy of notice is that, although our requ[illegible] ments for foreign wheat are becoming larger and la[illegible] the fluctuations in the amounts required from yea[illegible] year are becoming much less. Thus, after the season of 1860, the nett imports of wheat incre[illegible] from 4½ to 10 million quarters, or by more than 10[illegible] cent. In 1872-3 the imports were 3,000,000 qua[illegible] more than in the previous year, corresponding t[illegible] increase of about 33 per cent. But after the harve[illegible] 1879, the worst on record, when the nett impor[illegible] wheat increased from 14·1 to 16·4 million quarters, increase only amounted to about 16 per cent. D[illegible] the year ending August 31, 1881, the amount of fo[illegible] wheat retained for home consumption was more sixteen million quarters. As the area under wh[illegible] the United Kingdom was last year rather less 3,000,000 acres, a deficiency of half a quarter per in the yield of the crop, although a very serious m[illegible] so far as the interests of the cultivator are concerned, comparatively little influence on the requirements o[illegible] country at large for foreign wheat. I have no d[illegible] that my estimate of the home wheat crop of 188[illegible]

considerably too high. The average of the usually selected plots in my experimental wheat field showed a produce of 27 bushels, reckoned at 61 lb. per bushel. There was at that time sufficient evidence to show how exceedingly bad was the yield of the crop upon the lighter soils; nor can I now account for the fact that in that year wheat grown continuously was so much better than wheat grown in rotation. For example: in the experimental field of light soil at Woburn the land growing wheat every year showed but little difference between the crops in 1879 and 1880; but where, in the same field, wheat was grown in an ordinary four-course rotation, after clover fed off by stock with cake or corn, or without cake or corn, but an application of artificial manures, the produce of 1880 was from 11 to 16 bushels per acre less than under the same treatment in the very bad season of 1879! In the following table is given the produce in 1881, upon the same selected plots as usual, in the field at Rothamsted, which has now grown wheat for thirty-eight years in succession. There is also given for comparison the average produce on the same selected plots—over the last ten years, 1871-1880, over the preceding nineteen years, 1852-1870, and over the total period of twenty-nine years, 1852-1880, during which time the same manures have, in every case, been annually applied to the same plots:—

Harvests.	Unmanured. Plot 3.	Farmyard Manure. Plot 2.	Artificial Manures. Plot 7.	Artificial Manures. Plot 8.	Artificial Manures. Plot 9.	Means of Plots 7, 8, 9.	Means, of Plots 1, 2 and 7, 8, 9.
Bushels of Dressed Corn per Acre.							
1881	13¾	30¼	26⅝	30⅜	35½	30⅛	25
Average 10 years, 1871-80	9¾	29¾	26½	30⅛	34⅝	30¾	23⅞
Average 19 years, 1852-70	14¾	35¾	36	38¾	37	37¼	29¼
Average 29 years, 1852-80	13⅛	33⅝	32¾	36⅜	36¼	35	27¼
Weight per Bushel of Dressed Corn in Pounds.							
1881	58·0	58·9	58·8	59·1	58·4	58·8	58·6
Average 10 years, 1871-80	57·5	59·9	59·3	59·1	58·8	59·0	58·8
Average 19 years, 1852-70	58·2	60·0	59·4	59·1	58·4	59·0	59·1
Average 29 years, 1852-80	58·0	60·0	59·4	59·1	58·6	59·0	59·0
Total Straw, Chaff, &c., per Acre in Cwts.							
1881	10¼	21⅛	19⅞	26	32½	26	19⅛
Average 10 years, 1871-80	8½	29⅞	29½	37½	41⅞	36¼	24⅞
Average 19 years, 1852-1870	13¼	33⅝	35¾	41⅝	41⅝	39⅝	28⅝
Average 29 years, 1852-80	11⅛	32¼	33½	40¼	41½	38⅜	27⅜

These figures do not show much prospect of an abundant harvest. The yield per acre is low and the quality indifferent. In no case among the nearly forty plots in the experimental field does the weight per bushel reach 60 lb.; and the produce of straw is at the same time exceedingly low. In an adjoining field twenty-one varieties of wheat were grown side by side; not long before harvest the crops presented an exceedingly luxuriant appearance, and it was considered that the yield would be from 50 to 62 bushels per acre. The result of the threshing is, however, disappointing. The highest produce in the field is only 54 bushels per acre, with a weight per bushel of 57½ lb.; and the lowest produce is, in two cases, 39½ bushels—in one with a weight of 61 lb., and in the other of scarcely 59 lb. per bushel. It is, I think, quite evident that the yield of the wheat crop will vary very much, not only in different districts, but in the same district, and that in different fields on the same farm. The produce in my experimental field, taking the mean of the same selected plots as for many years past, shows an average of 24 bushels per acre, reckoned at 61 lb. per bush.; and assuming an average crop of wheat to be 28 bushels the crop is 14 per cent. below the average.

According to the returns of the Registrar-General, the population of the United Kingdom was a little below 35,000,000 on June 30, 1881. Making due allowance for the natural increase, the mean population to be fed during the year commencing September, 1, 1881, and ending August 31, 1882, will be 35,280,000. Estimating the consumption at 5⅝ bushels of wheat per head, the quantity required to feed the population will be a little under 25,000,000 quarters. The area under wheat in the United Kingdom was, during the past harvest year, slightly under 3,000,000 acres. If the yield in my experimental field be taken as a guide, the total wheat crop of the country would not amount to 9,000,000 quarters; and deducting from this the amount required for seed, the quantity of home-produced wheat left available for consumption would be only about 8,000,000 quarters, and we should thus have to depend upon foreign supplies for nearly 17,000,000 quarters. As however, wheat has risen considerably in price, and the potato crop is likely to be abundant, it is probable that our requirements for foreign wheat may be satisfied by an import equal to that which we have received during last the two years, namely, from 16,000,000 to 16,500,000 quarters. With a stationary or decreasing area under wheat, and a rapidly increasing population, it is probable that, before many years are pars, the home produce of wheat will not furnish more than one-fourth of the total amount required.

OPIUM IN CHINA.

In July, 1879, Mr. Robert Hart, Inspector-General of Customs at Peking, sent out a circular to the various Commissioners of Customs in China with a form of return, to be filled in with particulars on the following points:—1. How many catties (one catty = 1⅓lb. avoirdupois) of boiled or prepared opium can be got from 100 catties of the drug in the crude or unprepared state. 2. Price of unprepared and prepared opium. 3. Weight of prepared opium smoked daily by (*a*) beginners, (*b*) average smokers, (*c*) heavy smokers. 4. How many pipes, one mace of prepared opium will fill. 5. Price of one mace of prepared opium at the retail shops or smoking rooms. 6. Total of unprepared opium of foreign origin imported at each port. 7. Total quantity of unprepared opium of native origin said to be produced. 8. Presumed length of time (months or years) a man must smoke before the habit takes such hold on him that he cannot give it up. 9. Sum total of charges and taxes to which 100 catties of opium are liable after paying import duty. On obtaining replies to these inquiries, Mr. Hart set himself to answer the question:—How many smokers does the foreign drug supply? with the following results which are taken from his report lately published at Shanghai.

The annual importation of foreign opium may be set down, in round numbers, as 100,000 chests (weighing 100 catties each) or 10,000,000 catties. The raw drug loses about 30 per cent. in weight when boiled down and converted into prepared opium, so that it is 7,000,000 catties only that reach the hands of the retailer

catty, as already stated, is equal to about one pound and a third, avoirdupois. It is divided into 16 liang, and the liang is divided into tenths, called mace. The amount, therefore, of prepared opium for the supply of smokers is 120,000,000 mace. After paying import duties and likin taxes, the value of a mace of opium may be put at threepence half-penny. Average smokers consume three mace of prepared opium, and spend about 10½d. daily. This quantity suffices for from 30 to 40 pipes, *i.e.*, whiffs, or "draws." Taking this calculation, Mr. Hart arrives at the fact that, in round numbers, there are about 1,000,000 smokers of foreign opium. Taking the population of China at 300,000,000, this will give the result, that 3⅓ in every 1,000 smoke, or, that the practice is indulged in by one-third of one per cent. of the population.

Besides the foreign drug, there is the native product, which is largely used. No trustworthy statistics could be obtained of the amount produced, and the estimates vary so greatly that they can only be set down as guesses. Mr. Hart, however, holds that, as far as is known at present, the sale of the native drug cannot exceed the foreign import in quantity. Putting it at the same amount, we arrive at the fact that there are two million smokers, or two-thirds of one per cent of the population. The native product sells for one half of the price obtained for the foreign drug, and the total amount spent on the opium produced at home and imported from abroad is about £25,000,000 annually. Mr. Hart concludes his report with these words:—"Chinese who have studied the opium question are opposed to a traffic which more or less harms smokers, now numbering, say, over two millions, and annually increasing; at the same time, they admit that opium provides a large revenue, that the expenditure for opium, and liability to the incidence of opium taxation, touch an infinitesimally small per-centage of the population, and that neither the finances of the State, nor the wealth of its people, nor the growth of its population, can be specially damaged by a luxury which only draws from 5d. to 11d. a-piece a day from the pockets of those who indulge in it, and which is indulged in by only two-thirds of one per cent. of the population. They admit all this, but they do not find in either the revenue produced or the statistical demonstration of its per-centage innocuousness, any sufficient reason for welcoming the growth of the trade, or for desisting from the attempt to check the consumption of opium."

CORRESPONDENCE.

TANNING.

I am sure that we are upon the eve of a great change in the mode of tanning leather, and what is more to the point of this letter, viz., the transportation of the raw material, hitherto looked upon as "dried bark" or "dried wood." In the latter case, it has at present to be carefully granulated, or else the tanning substances will not yield to the action of cold water. Extracts are now so much more understood, and thanks to the rising generation having studied in most schools and colleges the rudiments of chemistry, they understand the extraction of substances from raw products, and can watch any change that takes place; with a "Tannometer" or "Tan Tester" at hand, anyone with some evaporating pans could extract rich tanning materials in Australia, in India, or in South America, and get them into almost a solid form, so that they could be shipped home in barrels or cases.

The tanners in this country now find that they can work with these extracts much more expeditiously than they could with the old-fashioned process of bark.

Many of your readers having friends in our Colonies will render them a great service if they will call their attention to this fact, so that they may not allow the trade to fall into the hands of the Americans, which is now yielding them such enormous profits.

THOS. CHRISTY.

GENERAL NOTES.

Merchant Shipping.—A chart, showing forty-five years' history of merchant shipping, has been issued as a supplement to the *British Trade Journal*. In this chart, the respective total tonnage of British, American, and French sailing vessels and steam-ships are given for each year since 1840, inclusive.

London Sanitary Protection Association.—The first general meeting of this association was held in the great room of the Society of Arts, on Tuesday evening, 25th inst., Prof. Huxley, F.R.S., in the chair. Prof. Fleeming Jenkin, F.R.S., narrated the progress and success of similar associations in Newport, U.S.A., in Wolverhampton, in Bradford, and especially in Edinburgh, and announced that an association was just being formed in Brighton. The Chairman said that this association might be called a co-operative store for the supply of good advice on sanitary matters. The success of this association would be for the general good. Mr. Timothy Holmes, the hon. treasurer, said that the state of finance was satisfactory, for though the income was small, the expenditure was still smaller, leaving a satisfactory balance in hand.

Patent Bill.—At a meeting of the Cleveland "Iron Trade" Foremen's Association, held in Middlesbro', Saturday, October 8th, 1881, a paper, by Sir Frederick J. Bramwell, C.E., on the Society of Arts' proposed Patent Bill, was read by the president, Mr. John M. Oubridge. In the discussion that ensued, an epitome of the Bill itself was read, by Mr. Jeremiah Head (honorary member of the association). The following resolutions were carried unanimously:—Proposed by Mr. Jeremiah Head, and seconded by Mr. J. M. Oubridge, and supported by several other gentlemen; 1st. "That the Cleveland 'Iron Trade' Foremen's Association heartily approves of the Society of Arts' proposed new Patent Bill, and pledges itself to support it by every available means." 2nd. It was proposed by Mr. J. M. Oubridge, and seconded by Mr. Robert Telford, "That Mr. Jeremiah Head be authorised and requested to communicate with Sir Frederick J. Bramwell, in order to obtain his advice as to the best means of carrying out the first resolution."

School Board Drill.—The annual drill competition of the London Board schools, for the challenge banner presented by the Society of Arts, took place on Saturday, [illegible] October, in the grounds of Lambeth Palace. About [illegible] boys from the following seventeen different Board Schools took part in the contest:—First column—1. Medburn-street, St. Pancras; 2. Thomas-street, Limehouse; 3. Plumstead-road; 4. Tennyson-road, Battersea; 5. Portman-place, Mile-end; 6. Penrose-street, Walworth; 7. Larkhall-lane, Clapham; 8. "D" Street, Queen's-park; 9. Battersea-park-road. Second column—1. London-fields, Hackney; 2. Harper-street, New Kent-road; 3. Bellenden-road, Peckham; 4. Sumner-road, Peckham; 5. Waterloo-street, Hammersmith; Fairfield-road, Bow; 7. Harwood-road, Fulham; 8. Westmoreland-road, Walworth. Each school was represented by forty boys and an instructor. The march past took place before the judges, Mr. Freeman (Vice-Chairman of the Board), Colonel Page, and Mr. John Macgregor (Rob Roy), and the companies drilled separately in different parts of the grounds. After a variety of company movements, the Medburn-street School (St. Pancras) and the Portman-place school (Mile-end) companies were marched to the front, and put to a final test to decide the victory, when the choice fell on the Mile-end boys. The next schools in order of merit were Medburn-street (St. Pancras), Thomas-street (Limehouse), the last winners of the competition, and the Tennyson-road School, Battersea.

NAL OF THE SOCIETY OF ARTS.

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FRIDAY, NOVEMBER 4, 1881.

unications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

ELECTRIC LIGHTING IN THEATRES.

R. D'Oyly Carte, the proprietor of the Savoy re, in the Strand, has kindly made arrange- for Members of the Society, who may wish so, to inspect the lighting arrangements of ivoy Theatre, on the afternoon of Saturday, th of November, at ten minutes before five. ers will be admitted on presentation of their g cards. Each member may be accompanied friend.

ARRANGEMENTS FOR THE SESSION.

first meeting of the One Hundred and ty-eighth Session of the Society will be held dnesday, the 16th inst., when the Opening ss will be delivered by Sir FREDERICK J. WELL, F.R.S., Chairman of the Council. ous to Christmas, there will be four ordinary ngs in addition to the opening meeting. didates proposed for election as members are ged to attend the opening meeting.

ORDINARY MEETINGS.

following arrangements for the Wednesday ngs before Christmas have been made:—

EMBER 16.—Opening Meeting of the Session. ss by Sir FREDERICK J. BRAMWELL, F.R.S., nan of the Council.

EMBER 23.—"The Storage of Electricity." By SYLVANUS THOMPSON, D.Sc.

EMBER 30.—Discussion on the Society of Arts' Bill, which will be continued on such other gs as may be found convenient. The discussion opened by Sir FREDERICK J. BRAMWELL, F.R.S., nan of the Council.

EMBER 7.—"The American System of Heating by Steam." By Capt. DOUGLAS GALTON, C.B.,

EMBER 14.—"Electric Lighting at the Paris ical Exhibition." By W. H. PREECE, F.R.S.

FOREIGN AND COLONIAL SECTION.

meetings of this Section will take place on the following Tuesday Evenings, at Eight o'clock:—

January 31; February 28; March 21; April 4, 25; May 23.

APPLIED CHEMISTRY AND PHYSICS SECTION.

The meetings of this Section will take place on the following Thursday Evenings, at Eight o'clock:—

January 26; February 23; March 9, 30; April 27; May 11.

INDIAN SECTION.

The meetings of this Section will take place on the following Friday Evenings, at Eight o'clock:—

February 17; March 17, 31; April 21; May 12, 26.

CANTOR LECTURES.

The First Course will be on "Some of the Industrial Uses of the Calcium Compounds." By THOMAS BOLAS, F.C.S.

November 21, 28; December 5, 12.

The Second Course will be on "Recent Advances in Photography." By CAPT. ABNEY, R.E., F.R.S.

January 30; February 6, 13, 20.

The Third Course will be on "Hydraulic Machinery." By PROF. JOHN PERRY.

March 6, 13, 20, 27.

The Fourth Course will be on "Book Illustration, Old and New." By J. COMYNS CARR.

April 20; May 1, 8, 15.

JUVENILE LECTURES.

The two Juvenile Lectures will be by W. H. PREECE, F.R.S., on "Recent Wonders of Electricity." The dates for these are Wednesday evenings, December 28 and January 4. A full programme of the Sessional Arrangements will be given in next week's *Journal*.

SOCIETY OF SCIENCE, LETTERS, AND ART.

It having come to the knowledge of the Secretary that circulars, purporting to be issued by "The Society of Science, Letters, and Art, of London," or some similar title, and dated from Finsbury-park or Upper Tollington-park, have been sent to certain Members of the Society of Arts, inviting them to subscribe to the "Society of Science, Letters, and Art," and that several subscriptions have been paid to the secretary of the above institution, under the impression that it was connected with the Society of Arts, he is desired to give notice that nothing whatever is known of such a society at this office, and that it is not associated in any way with the Society of Arts.

SOME OF THE DEVELOPMENTS OF MECHANICAL ENGINEERING DURING THE LAST HALF-CENTURY.*

By Sir Frederick Bramwell, V.P. Inst. C.E., F.R.S.

Chairman of the Council of the Society of Arts.

I am quite sure the Section will agree with me in thinking, it was very fortunate for us, and for science generally, that our President refrained from occupying the time of the Section by a retrospect, and devoted himself, in that lucid and clear address with which he favoured us, to the consideration of certain scientific matters connected with engineering, and to the foreshadowing of the directions in which he believes it possible that further improvements may be sought for. But I think it is desirable that some one should give to this Section a record, even although it must be but a brief and an imperfect one, of certain of the improvements that have been made, and of some of the progress that has taken place, during the last fifty years, in the practical application of mechanical science, with which science and its applications our Section is particularly connected. I regret to say that, like most of the gentlemen who sat on this platform yesterday, who, I think, were, without exception, past presidents of the Section, I am old enough to give this record from personal experience. Fifty years ago, I had not the honour of being a member, nor should I, it is true, have been eligible for membership of the Association; but I was at that time vigorously making models of steam-engines, to the great annoyance of the household in which I lived, and was looking forward to the day when I should be old enough to be apprenticed to an engineer. Without further preface, I will briefly allude to some of the principal developments of a few of the branches of engineering. I am well aware that many branches will be left unnoticed; but I trust that the omissions I may make will be remedied by those present who may speak upon the subject after me.

I will begin by alluding to the *Steam-engine employed for manufacturing purposes*. In 1831, the steam-engine for these purposes was commonly the condensing beam engine, and was supplied with steam from boilers, known, from their shape, as waggon boilers; this shape appears to have been chosen rather for the convenience of the sweeps, who periodically went through the flues to remove the soot consequent on the imperfect combustion, than for the purpose of withstanding any internal pressure of steam. The necessary consequence was, that the manufacturing engines of those days were compelled to work with steam of from only $3\frac{1}{2}$ lbs. to 5 lbs. per square inch of pressure above atmosphere. The piston speed rarely exceeded 250 feet per minute, and as a result of the feeble pressure, and of the low rate of speed, very large cylinders indeed were needed relatively to the power obtained. The consumption of fuel was heavy, being commonly from 7 lbs. to 10 lbs. per gross indicated horse-power per hour. The governing of the engine was done by pendulum governors, revolving slowly, and not calculated to exert any greater effort than that of raising the balls at the end of the pendulum arms, thus being, as will be readily seen, very inefficient regulators. The connection of the parts of the engine between themselves was derived from the foundation upon which the engine was supported. Incident to the low piston speed, was slowness of revolution, rendering necessary heavy fly-wheels, to obtain even an approach to practical uniformity of rotation, and frequently rendering necessary also heavy trains of toothed graining, to bring up the speed from that of the revolutions of the engine to that of the machinery it was intended to drive.

In 1881, the boilers are almost invariably cylindrical, and are very commonly internally fired, either by one flue or by two; we owe it to the late Sir William Fairbairn, President of the British Association in 1861, that the danger, which at one time existed, of the collapse of these fire flues, has been entirely removed by his application of circumferential bands. Now-a-days there are, as we know, modifications of Sir William Fairbairn's bands, but by means of his bands, or by modifications thereof, all internally flued boilers are so strengthened, that the risk of a collapse of the flue is at an end. Boilers of this kind are well calculated to furnish—and commonly do furnish—steam of from 40 lb. to 80 lb. pressure above atmosphere. The piston speed is now very generally 400 feet or more, so that, notwithstanding that there is usually a liberal expansion, the mean pressure upon the piston is increased, and this, coupled with its increased speed, enables much more power to be obtained from a given size of cylinder than was formerly obtainable. The revolutions of the engine now are as many as from 60 to 200 per minute, and thus, with far lighter fly-wheels, uniformity of rotation is much more nearly attained. Moreover, all the parts of the engine are self-contained; they no longer depend upon the foundation, and in many cases the condensing is effected either by surface condensers, or, where there is not sufficient water, the condensation is, in a few instances, effected by the evaporative condenser—a condenser which, I am sorry to say, is not generally known, and is therefore but seldom used, although its existence has been nearly as long as that of the Association. Notwithstanding the length of time during which the evaporative condenser has been known to some engineers, it is a common thing to hear persons say, when you ask them if they are using a condensing engine, "I cannot use it; I have not water enough." A very sufficient answer indeed, if an injection condenser, or an ordinary surface condenser, constituted the sole means by which a vacuous condition might be obtained; but a very insufficient answer, having regard to the existence of the evaporative condenser, as by its means, whenever there is water enough for the feed of a non-condensing engine, there is enough to condense, and to produce a good vacuum. The evaporative condenser simply consists of a series of pipes, in which is the steam to be condensed, and over which the water is allowed to fall in a continuous rain. By this arrangement there is evaporated from the outside of the condenser a weight of water which goes away in a cloud of vapour, and is nearly equal to that which is condensed, and is returned as feed into the boiler. The same water is pumped up and used outside the condenser, over and

* Paper read in Section G. (Mechanical) of the British Association.

over, needing no more to supply the waste than would be needed as feed water. Although this condenser has, as I have said, been in use for thirty or forty years, one still sees engines working without condensation at all, or with water-works water, purchased at a great cost, and to the detriment of other consumers, who want it for ordinary domestic purposes; or one sees large condensing ponds made, in which the injection water is stored, to be used over and over again, and frequently (especially towards the end of the week) in so tepid a state as to be unfit for its purpose. The governing is now done by means of quick-running governors, which have power enough in them to raise not merely the weight of the pendulum ball, which is now small, but a very heavy weight, and in this way the governing is extremely effective. I propose to say no more, looking at the magnitude of the whole of my subject, upon the engine used for manufacturing purposes, but rather to turn at once to those employed for other objects.

Steam navigation.—In 1831, there were a considerable number of paddle steamers running along some of the rivers in England, and across the Channel to the Continent. But there were no ocean steamers, properly so-called, and there were no steamers used for warlike purposes. As in the case of the waggon boilers, the boilers of the paddle steamers of 1831 were most unsuited for resisting pressure. They were mere tanks, and there was as much pressure when there was no steam in the boiler from the weight of the water on the bottom, as there was at the top of the boiler from the steam pressure when the steam was up. Under these circumstances again, from 3½ lbs. to 5 lbs. was all the pressure the boilers were competent to bear, and as the engines ran at a slow speed, they developed but a small amount of horse-power in relation to their size. Moreover, as in the land engine, the connection between the parts of the marine engine was such as to be incompetent to stand the strain that would come upon it if a higher pressure, with a considerable expansion, were used, and thus the consumption of coal was very heavy; and we know, that having regard to the then consumption, it was said on high authority, it would be impossible for a steamboat to traverse the Atlantic, as it could not carry fuel enough to take it across; and indeed it was not until 1838 that the *Sirius* and the *Great Western* did make the passage. The passage had been made before, but it was not until 1838 that the passenger service can be said to have commenced. In 1831, the marine boiler was supplied with salt water, the hulls were invariably of wood, and the speed was probably from eight to nine knots an hour. In 1881, the vessels are as invariably either of iron or of steel, and I believe it will not be very long before the iron disappears, giving place entirely to the last-mentioned metal. With respect to the term "steel," I am ready to agree that it is impossible to say where, chemically speaking, iron ends and steel begins. But (leaving out malleable cast iron) I apply this term "steel" to any malleable ductile metal of which iron forms the principal element, and which has been in fusion, and I do so in contra-distinction to the metal which may be similar chemically, but which has been prepared by the puddling process. Applying the term steel in that sense, I believe, as I have said, it will not be very long before plate-iron produced by the puddling process will cease to be used for the purpose of building vessels. With respect to marine engines, they are now supplied with steam from multiple-tubed boilers, the shells of which are commonly cylindrical. They are of enormous strength, and made with every possible care, and carry from 80 lbs. to 100 lbs. pressure on the square inch. It has been found, on the whole, more convenient to expand the steam in two or more cylinders, rather than in one. I quite agree that, as a mere matter of engineering science, there is no reason why the expansion should not take place in a single cylinder, unless it be that a single cylinder is cooled down to an extent which cannot be overcome by jacketting, and which, therefore, destroy, a portion of the steam on its entering into the cylinder. As regards the propeller, as we know, except in certain cases, the paddle-wheel has practically disappeared, and the screw propeller is all but universally employed. The substitution of the screw propeller for the paddle enables the engine to work at a much higher number of revolutions per minute, and thus a very great piston speed, some 600 ft. to 800 ft. per minute is attained; and this, coupled with the fairly high mean pressure which prevails, enables a large power to be got from a comparatively small-sized engine. Speeds of 15 knots an hour are now in many cases maintained, and on trial trips are not uncommonly exceeded. Steam vessels are now the accepted vessel of war. We have them in an armoured state, and in an unarmoured state, but when unarmoured rendered so formidable, by the command which their speed gives them of chosing their distance, as to make them, when furnished with powerful guns, dangerous opponents even to the best armoured vessels. We have also now marine engines, governed by governors of such extreme sensitiveness, as to give them the semblance of being endowed with the spirit of prophecy, as they appear rather to be regulating the engine for that which is about to take place than for that which is taking place. This may sound a somewhat extravagant statement, but it is so nearly the truth, that I have hardly gone outside of it in using the words I have employed. For a marine governor to be of any use, it must not wait till the stern of the vessel is out of the water before it acts to check the engine and reduce the speed. Nothing but the most sensitive and, indeed, anticipatory action of the governors can efficiently control marine propulsion. Instances are on record of vessels having engines without marine governors being detained by stress of weather at the mouth of the Thames, while vessels having such governors, of good design, have gone to Newcastle, have come back, and have found the other vessels still waiting for more favourable weather. With respect to condensation in marine engines, it is almost invariably effected by surface condensers, and thus it is that the boilers, instead of being fed with salt water as they used to be, involving continuous blowing off, and frequently the salting up, of the boiler, are now fed with distilled water. It should be noticed, however, that in some instances, owing to the absence of a thin protecting scale upon the tubes and plates, very considerable corrosion has taken place with distilled water, derived from condensers having

tinued brass tubes, has been used, and where the water has carried into the boiler fatty acids, arising from the decomposition of the grease used in the engine; but means are now employed by which these effects are counteracted.

I wish, before quitting this section of my subject, to call your attention to two very interesting, but very different, kinds of marine engines. One is the high-speed torpedo vessel, or steam launch, of which Messrs. Thornycroft's firm have furnished so many examples. In these, owing to the rate at which the piston runs to the initial pressure of 120 lbs., and to very great skill in the design, Messrs. Thornycroft have succeeded in obtaining a gross indicated horse-power for as small a weight as half a cwt., including the boiler, the water in the boiler, the engine, the propeller shaft, and the propeller itself.

To obtain the needed steam from the small and light boiler, recourse has to be made to the aid of a fan blast driven into the stoke-hole. From the use of a blast in this way advantages accrue. One is, as already stated, that from a small boiler a large amount of steam is produced. Another is that the stoke-hole is kept cool; and the third is that artificial blasts thus applied are unaccompanied by the dangers which arise, when under ordinary circumstances the blast is supplied only to the ash-pit itself. The second marine engine to which I wish to call your attention, is one that has been made with a view to great economy. The principles followed in its construction are among those suggested by the President (Sir W. G. Armstrong) in his address. He (you will remember) pointed out that the direction in which economy in the steam-engine was to be looked for was that of increasing the initial pressure; although at the same time he said that there were drawbacks in the shape of greater loss, by radiation, and by the higher temperature at which the products of combustion would escape. We must admit the fact of the latter source of loss, when using very high steam, it being inevitable that the temperature of the products of combustion escaping from a boiler under these conditions must be higher than those which need be allowed to escape when lower steam is employed; although I regret to say that in practice in marine boilers working at comparatively low pressures the products are ordinarily suffered to pass into the funnel at above the temperature of melted lead. But with respect to the loss by radiation in the particular engine I am about to mention—that of Perkins—there is not as much loss as that which prevails in the ordinary marine boilers, because the Perkins boiler is completely enclosed, with the result that while there is within the case a boiler containing steam of 400 lbs. on the square inch, and the fire to generate that steam, the hand may be applied to the casing itself, which contains the whole of the boiler, without receiving any unpleasant sensation of warmth. By Mr. Perkins's arrangement, using steam of 400 lbs. in the boiler, it was found, as the result of very severe trials, conducted by Mr. Rich, of Messrs. Easton and Anderson's firm, and myself—trials which lasted for twelve hours—that the total consumption of fuel, including that for getting up steam from cold water, was just under 1·8, actually 1·79 lb. per gross indicated horse-power per hour. That gross indicated horse-power was obtained in a manner which it is desirable should always be employed in steamboat trials. It was not got by using as a divisor the horse-power of the most favourable diagram obtained during the day; but it was got from diagrams taken during the regular work; then, every half-hour, when the pressure began to die down from coal being no longer put upon the fire, diagrams taken every quarter-of-an-hour, and then, towards the last, every five minutes; and the total number of foot pounds were calculated from these diagrams, and were used to obtain the gross indicated horse-power.

Further, so far as could be ascertained by the process of commencing a trial with a known fire, and closing that trial at the end of six hours, with the fire as nearly as possible in the same condition, the consumption was 1·66 lbs. of coal per gross indicated horse-power per hour. So that, without taking into account the coal consumed in raising steam from cold water, the engine worked for 1¾ lbs. of coal per horse per hour. I think it well to give these details, because undoubtedly it is an extremely economical result. Our President alluded to the employment of ether as a means of utilising the heat which escaped into the condenser, and gave some account of what was done by Mons. Du Tremblay in this direction. It so happened that I had occasion to investigate the matter at the time of Du Tremblay's experiments: very little was effected here in England, one difficulty being the Excise interference with the manufacture of ether. Chloroform was used here, and it was also suggested to employ bi-sulphide of carbon. In France, however, a great deal was done. Four large vessels were fitted with the ether engines, and I went over to Marseilles to see them at work. I took diagrams from these engines, and there is no doubt that, by this system, the exhaust steam from the steam cylinder, which was condensed by the application of ether to the surface of the steam condenser (producing a respectable vacuum of about 22 inches), gave an ether pressure of 15 lbs. on the square inch above atmosphere, and very economical results as regards fuel were obtained. The scheme was, however, abandoned from practical difficulties. It need hardly be said that ether vapour is very difficult to deal with, and although ether is light the vapour is extremely heavy, and if there is any leakage, it goes down into the bilges by gravitation, and being mixed with air, unless the care is taken to prevent access to the fire, there would be a constant risk of a violent explosion. In fact, it was necessary to treat the engine-room in the way in which a fiery colliery would be treated. The lighting, for instance, was by lamps external to the engine-room, and shining through thick plate-glass. The hand lamps were Davy's. The ether engine was a bold experiment in applied science, and one that entitles Du Tremblay's name to be preserved, and to be mentioned as it was by our President. There was another kind of marine engine, that I think should not be passed over without notice; I allude to Howard's quicksilver engine. The experiments with this engine were persevered in for some considerable time, and it was actually used for practical purposes in pro-

elling a passenger steam-vessel called the *Vesta*, nd running between London to Ramsgate. In iat engine the boiler had a double-bottom, coniining an amalgam of quicksilver and lead. This malgam served as a reservoir of heat, which it took p from the fire below the double-bottom, and gave orth at intervals to the water above it. There was o water in the boiler, in the ordinary sense of the erm, but when steam was wanted to start the ngine, a small quantity of water was injected by eans of a hand-pump, and after the engine was tarted, there was pumped by it into the boiler, t each half revolution, as much water as would ake the steam needed. This water was flashed n the top surface of the reservoir in which the malgam was confined, and was entirely turned ito steam, the object of the engineers in charge eing to send in so much water as would just enerate the steam, but so as not to leave any ater in the boiler. The engines of the *Vesta* ere made by Mr. Penn, for Mr. Howard, of the ing and Queen Ironworks, Rotherhithe. Mr. oward, was, I fear, a considerable loser by s meritorious efforts to improve the steamigine.

There was used, with this engine, an almost iknown mode of obtaining fresh water for e boiler. Fresh water, it will be seen, was a cessity in this mode of evaporation. The prence of salt, or of any other impurity, when the iole of the water was flashed into steam, must ve caused a deposit on the top of the amalgam amber at each operation. Fresh water, therere, was needed; the problem arose how to et it; and that problem was solved, not by ie use of surface condensation, but by the nployment of re-injection, that is to say, e water delivered from the hot-well was passed to pipes external to the vessel; after traversing em, it came back into the injection tank suffiently cooled to be used again. The boilers were orked by coke fires, urged by a fan blast in their hpits, but I am not aware that this mode of ing was a needful part of the system.

I come now to the *Engines used for railways*. At ie British Association meeting of 1831, the Manester and Liverpool Railway had been opened aly about a year. The Stockton and Darlington al line, it is true, had carried passengers by steamower as early as 1825, but I think we may look pon the Manchester and Liverpool as being the eginning of the passenger and mercantile railway ystem of the present day. At that time the locootives weighed from eight to ten tons, and the peed was about 20 miles per hour, with a pressure f from 40 to 50 lbs. The rails were light; they rere jointed in the chairs, which were generally arried on stone blocks, thus affording most excelent anvils for the battering to pieces of the ends f the rails—that is to say, for the destruction of he very parts where they were most vulnerable. The engines were not competent to draw heavy rains, and it was a common practice to have at he foot of an incline a shed containing a "bankengine," which ran out after the trains as they passed, and pushed them up to the top of the hill. Injectors were then unknown, and donkey-pumps were unknown, and therefore, when it was necessary to fill up the boiler, if it had not been properly pumped up before the locomotive came to rest, it had to run about the line in order to work its feed-pumps. To get over this difficulty, it was occasionally the practice to insert into a line of rails, in a siding, a pair of wheels, with their tops level with that of the rails so that the engine wheels could run upon the rims. Then, the locomotive being fixed to prevent it from moving of the pair of wheels thus endways, it was put into revolution, its driving wheels bearing, as already stated, upon the rims of the pair of wheels in the rails, and thus the engine worked its feed pumps without interfering (by its needless running up and down the line) with the traffic. It should have been stated that at this time there was no link motion, no practical expansion of the steam, and that even the reversal of the engine had to be effected by working the slides by hand gear, in the manner in use in marine engines. When the British Association originated, although the Manchester and Liverpool Railway had been opened for a year, there is no doubt that the 300 members who then came to this City found their way here by the slow process of the stage-coach, the loss of which we so much deplore in the summer and in fine weather, but the obligatory use of which we should so much regret in the miserable weather now prevailing in these islands.

In 1881, we know that railways are everywhere inserted. Steel rails, double the weight of the original iron ones, are used. Wooden sleepers have replaced the stone blocks, and they, in their turn, will probably give way to sleepers of steel. The joints are now made by means of fishplates, and the most vulnerable part of the rail, the end, is no longer laid on an anvil for a purpose of being smashed to pieces, but the ends of the rails are now almost always over a void, and thereby are not more affected by wear than is any other part of the rail. The speed is now from 50 to 60 miles an hour for passenger trains, while slow speed goods engines, weighing 45 tons, draw behind them coal trains of 800 tons. The injector is now commonly employed, and, by its aid, a careful driver of the engine of a stopping train can fill up his boiler while at rest at the stations. The link motion is in common use, to which, no doubt, is owing the very considerable economy with which the locomotive engine now works.

As regards the question of safety, it is a fact that, notwithstanding the increased speed, railway accidents are fewer than they were at the slow speed. It is also a fact that, if the whole population of London were to take a railway journey, there would be but one death arising out of it. Four millions of journeys for one death of a passenger from causes beyond his own control is, I believe, a state of security which rarely prevails elsewhere. As an instance, the street accidents in London alone cause between 200 and 300 deaths per annum. This safety in railway travelling is no doubt largely due to the block system, rendered possible by the electric telegraph; and also to the efficient interlocking of points and signals, which render it impossible now for a signalman to give an unsafe signal. He may give a wrong one, in the sense of inviting the wrong train to come in; but, although wrong in this sense, it would still be safe for that train to do so. If he can give a signal, that signal never invites to danger; before he can give it, every one of the signals, which ca

to be "at danger," must be "at danger," and every "point" must have been previously set, so as to make the road right; then, again, we have the facing point-lock, which is a great source of safety.

Further, we have continuous brakes of various kinds, competent in practice to absorb three miles of speed in every second of time; that is to say, if a train were going 60 miles an hour, it can be pulled up in 20 seconds; or, if at the rate of 30 miles, in 10 seconds. With a train running at 50 miles an hour, it can be pulled up in from 15 to 20 seconds, and in a distance of from 180 to 240 yards. Moreover, in the event of the train separating into two or more sections, the brakes are automatically applied to each section, thereby bringing them to rest in a short time. Another cause of safety is undoubtedly the use of weldless tyres. I was fortunate enough to attend the British Association Meeting many years ago at Birmingham, and I then read a paper upon weldless tyres, in which I ventured to prophesy that, in ten years time, there would not be a welded tyre made; that is one of the few prophecies that, being made before the event, have been fulfilled. I may perhaps be permitted to mention, that at the same time I laid before the Section plans and suggestions for the making of the cylindrical parts of boilers equally without seam, or even welding. This is rarely done at the present time, but I am sure that, in twenty years time, such a thing as a longitudinal seam of rivets in a boiler will be unknown. There is no reason why the successive rings of boiler shells should not be made weldless, as tyres are now made weldless.

The next subject I intend to deal with is that of *Motors*. In 1831, we had the steam-engine, the water-wheel, the windmill, horse-power, manual power, and Stirling's hot-air engines. Gas engines, indeed, were proposed in 1824, but were not brought to the really practical stage. We had then tide mills; indeed, we have had them until quite lately, and it may be that some still exist; they were sources of economy in our fuel, and their abandonment, is to me a matter of regret. I remember tide mills on the coast between Brighton and Newhaven, another between Greenwich and Woolwich, another at Northfleet, and in many other places. Indeed, such mills were used pretty extensively; they were generally erected at the mouth of a stream, and in that way the river bed made the reservoir, and even when they were erected in other situations, those were of a kind suitable for the purpose, that is, low lying lands were selected, and were embanked to form reservoirs. In 1881, windmills and water-wheels are much the same, but the turbines are greatly improved, and by means of turbines we are enabled to make available the pressure derived from heads of water which formerly could not be used at all, or if used, involved the erection of enormous water-wheels, such as those at Glasgow and in the Isle of Man, wheels of some eighty feet in diameter. But now, by means of a small turbine, an excellent effect is produced from high heads of water. The same effect is obtained from the water-engines which our President has employed with such great success. In addition to these motors, we have the gas-engine, which, within the last few years only, has become a really useful working and economical machine. With respect to horse-power motors, we have not only the old horse engines,) but we have a new application (as it seems to me, of the work of the horse as a motor. I allude to those cases where the horse drawing a reaping or threshing machine, not only pulls it forward as he might pull a cart, but causes its machinery to revolve, so as to perform the desired kind of work. This species of horse-engine, though known, was but little used in 1831. With respect to hot-air engines there have been many attempts to improve them and some hot-air engines are working, and are working with considerable success; but the amount of power they develop in relation to their size is small, and I am inclined to doubt whether it can be much increased.

I now come to the subject of the *transmission of power*. I do not mean transmission in the ordinary sense by means of shafting, gearing, or belting, but I mean transmission over long distances. In 1831, we had for this purpose flat rods, as they were called, rods transmitting power from pumping engines for a considerable distance to the pits where the pumps were placed, and we had also the pneumatic, the exhaustion system—the invention of John Hague, a Yorkshireman, my old master, to whom I was apprenticed—which mode of transmission was then used to a very considerable extent. The recollection of it, I find, however, has nearly died out, and I am glad to have this opportunity of reviving it. But in 1881, we have, for the transmission of power, first of all, quick moving ropes, and there is not, so far as I know, a better instance of this system than that at Schaffhausen. Anyone who has ever, in recent years, gone a mile or two above the falls at Schaffhausen must have seen there—in a house, on the bank of the Rhine, opposite to that on which the town is situated—large turbines driven by the river, which is slightly dammed up for the purpose These work quick-going ropes carried on pulleys, erected at intervals along the river bank, for the whole length of the town; and power is delivered from them to shafting below the streets, and from it into any house where it is required for manufacturing purposes. Then we have the compressed air transmission of power which is very largely used for underground engines, and for the working of rock drills in mines and tunnels. We have also compressed air in a portable form, and it is now employed with great success in driving tram-cars. I had occasion last January to visit Nantes, where, for eighteen months, tram-cars had been driven by compressed air, carried on the cars themselves, coupled with an extremely ingenious arrangement for overcoming the difficulties commonly attendant on the use of compressed air engines. This consists in the provision of a cylindrical vessel half filled with hot water and half with steam, at a pressure of eighty pounds on the square inch. The compressed air, on its way from the reservoir to the engine, passes through the water and steam, becoming thereby heated and moistened, and in that way all the danger of forming ice in the cylinders was prevented, and the parts were susceptible of good lubrication. These cars, which start every ten minutes from each end, make a journey of $3\frac{3}{4}$ miles, and have proved to be a commercial and an engineering success. I believe, moreover,

that they are capable of very considerable improvement. Then there is, although not much used, the transmitting of power by means of long steam pipes. There is also the transmission hydraulically. This may be carried out in an intermittent manner, so as to replace the reciprocating flat rods of old days; that is to say, if two pipes containing water are laid down, and if the pressure in those pipes at the one end be alternated, there will be produced an alternating and a reciprocative effect at the other, to give motion to pumps or other machinery. There is also that thoroughly well known mode of transmission, hydraulically, for which the engineering world owes so much to our President. We have, by Sir William Armstrong's system, coupled with his accumulator, the means of transmitting hydraulically the power of a central motor to any place requiring it, and by the means of the principal accumulator, or if need be, by that aided by local accumulators, a comparatively small engine is enabled to meet very heavy demands made upon it for a short time. I think I am right in saying that, at the ordinary pressure which Sir William Armstrong uses in practice, viz., 700 lbs. to the square inch, one foot a second of motion along an inch pipe would deliver at the rate to produce one-horse power. Therefore, a ten-inch pipe, with the water travelling at no greater pace than three feet in a second, would deliver 300-horse power. This 300-horse power would no doubt be somewhat reduced by the loss in the hydraulic engine, which would utilise the water. But the total energy received would be equivalent to producing 300-horse power. Such a transmission would be effected with an exceedingly small loss in friction in transit. I believe I am right in saying that a 10-inch pipe a mile long would not involve much more than about 14 or 15 lbs. differential pressure to propel the water through it at a rate of three feet in a second. If that be so, then, with 700 lbs. to the inch, the loss under such circumstances would be only two per cent. in transmission. There is no doubt that this transmission of power hydraulically has been of the greatest possible use. It has enabled work to be done which could not be done before. Enormous weights are raised with facility wherever required, as by the aid of power hydraulically transmitted, it is perfectly easy for one man to manage the heaviest cranes. Moreover, as I have said in other places, the system which we owe to Sir William Armstrong has gone far to elevate the human race, and it has done so in this manner. So long as it is competent for a man to earn a living by mere unintelligent exercise of his muscles, he is very likely to do it. You may see in the old London docks the crane-heads covered by structures that look like paddle-boxes. If you go to them, there is, I am glad to say, nothing now to fill them up; but when the British Association first met, these paddle-boxes covered large treadwheels, in which the men trod, so as to raise a weight. Now, although I know that in fact there is nothing more objectionable in a man turning a wheel by treading inside of it than there is if he turn it round by a winch-handle, yet somehow it strikes one more as being merely the work of an animal, a turnspit, or a squirrel, or indeed as the task imposed on the criminal. But, nevertheless, in this way there were a large number of persons getting their living by the mere exercise of their muscles, but, as might be expected, a very poor living, derived as it was from unintelligent labour. That work is no longer possible, and is not so, for the powerful reason that it does not pay. Those persons, therefore, who would now have been thus occupied, are compelled to elevate themselves, and to become competent to earn their living in a manner which is more worthy of an intelligent human being. It is on these grounds that I say we owe very much the elevation of the working classes, especially of the class below the artisan, to this invention of our distinguished President. In addition to the modes of transmission I have already mentioned, there is the transmission of power by means of gas. I think that there is a very large future indeed for gas engines. I do not know whether this may be the place to state it, but I believe the way in which we shall utilise our fuel hereafter will, in all probability, not be by the way of the steam-engine. Sir William Armstrong alluded to this probability in his address, and I entirely agree, if he will allow me to say so, that such a change in the production of power from fuel appears to be impending, if not in the immediate future, at all events in a time not very far remote; and however much the Mechanical Section of the British Association may to-day contemplate with regret, even the mere distant prospect of the steam-engine being a thing of the past, I very much doubt whether those who meet here fifty years hence will then speak of it as anything more than a curiosity to be found in a museum. With respect to the transmission of power electrically, I won't venture to touch upon that; but will content myself by reminding you that while Sir William Armstrong did say that there were comparatively small streams which could be utilised, he did not inform you of that which he himself had done in this direction; let me say that Sir William Armstrong thus utilised a fall of water, situated about a mile from his house, to work a turbine, which drives a dynamo machine, generating electricity, for the illumination of the house. When I was last at Crag Side, that illumination was being effected by the arc light, but since then, as Sir William Armstrong has been good enough to write to me, he has replaced the arc light by the incandescent lamp (a form of electrical lighting far more applicable than the arc light to domestic purposes), and with the greatest possible success. Thus, in Sir William Armstrong's own case, a small stream is made to afford light in a dwelling a mile away. Certainly nothing could have seemed more improbable fifty years ago than that the light of a house should be derived from a fall of water without the employment of any kind or description of fuel.

The next subject upon which I propose to touch, is that of the *Manufacture of iron and the steel.* In 1831, Neilson's hot blast specification had been published for 2½ years only. The Butterly Company had tried the hot blast for the first time in the November preceding the meeting of the British Association. The heating of the blast was coming very slowly into use, and the tem-

are closed, and the blast—thanks to the use of Mr. E. A. Cowper's stoves—is at 1,200 degrees. The manufacture of iron has also now enlisted in its service the chemist as well as the engineer, and amongst those who have done much for the improvement of the blast furnaces, to no one is greater praise due than to Mr. Isaac Lowthian Bell, who has brought the manufacture of iron to the position of a highly scientific operation. In the production of wrought iron by the puddling process, and in the subsequent mill operations, there is no very considerable change, except in the magnitude of the machines employed, and in the greater rapidity with which they now run. In saying this, I am not forgetting the various "mechanical puddlers" which have been put to work, nor the attempts that have been made by the use of some of them to make wrought iron direct from the ore; but neither the "mechanical puddler" nor the "direct process" have yet come into general use; and I desire to be taken as speaking of that which is the ordinary process pursued at the present in puddled iron manufactures. In 1831, a few hundredweights was the limit of weight of a plate, while in 1881, there may readily be obtained, for boiler-making purposes, plates of at least four times the weight of those that were made in 1831. I may, perhaps, be allowed to say that there is an extremely interesting Blue-book of the year 1818, containing the report of a Parliamentary Committee which sat on boiler explosions, and I recommend any mechanical engineer who is interested in the history of the subject to read that book; he will find it there stated that in the North of England there were a species of engines called locomotives, the boilers of which were made of wrought iron beaten, not rolled, because the rolled plate was not considered fit; it was added that if made of beaten iron the boiler would last at least a year. In 1831, thirteen years later, the dimensions of rolled plates were no doubt raised; but few then would have supposed it possible there should be

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1831, the process in use was
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Bridges.—In the year 1831,
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would have been needed if no wind had aken into account, and if the question of iple weight to be carried had alone to be red. With respect to the foundation of , that ingenious man, Lord Cochrane, d a mode of sinking foundations, even before meeting of the British Association, viz., as far believe, as 1825 or 1826; and the improve-which he then invented are almost universally in bridge construction at the present day. ers sunk by the aid of compressed air, air-obtain access to the cylinder, and in fact every that I know of as having been used in the sinking of cylinder foundations, were d by Lord Cochrane (afterwards Earl of ald) in that specification.

ext subject I propose to touch on, is that *ine Tools*. In 1831, the mention of lathes, machines, and screwing machines, brings r nearly to the end of the list of the tools used by turners and fitters, and at e many lathes were without slide rests. ermaker had then his punching-press and machine; the smith, leaving on one side es and their bellows, had nothing but hand d the limit of these was a huge hammer, handles, requiring two men to work it. or manufacture, it is true, a mechanical mmer, known as a Hercules, was employed, iron works, the Helve and the Tilt ham-re in use. For ordinary smith's work, r, there were, as has been said, practically hine tools at all.

paucity or absence in some trades, as we en, of machine tools, involved the need of nsiderable skill on the part of the work-It required the smith to be a man not great muscular power, but to be possessed accurate eye and a correct judgment, in o produce the forgings which were de-l of him, and to make the sound work that eded, especially when that soundness was d in shafts, and in other pieces which, in lays, were looked upon as of magnitude; indeed, they were, relatively to the tools could be brought to operate upon them. iler-maker in his work had to trust almost y to the eye for correctness of form and for ity of punching, while all parts of engines achines which could not be dealt with in the, in the drilling, or in the screwing e, had to be prepared by the use of the nd the file.

e present day, the turning and fitting shops nished, not only with the slide lathe, self-in both directions, and screw-cutting, the g machine, and the screwing machine, but laning machines competent to plane hori-y, vertically, or at an angle; shaping es, rapidly reciprocating, and dealing with any form of work; nut-shaping machines, illing machines, and slotting machines, he drills have become multiple and radial; e accuracy of the work is ensured by testing e surface plates, and by the employment of orth internal and external standard gauges. boiler-maker's tools now comprise the steam, essed air, hydraulic or other mechanical r, rolls for the bending of plates while cold e needed cylindrical or conical forms, multiple drills for the drilling of rivet holes, planing machines to plane the edges of the plates, ingenious apparatus for flanging them, thereby dispensing with one row of rivets out of two, and roller expanders for expanding the tubes in locomotive and in marine boilers; while the punching press, where still used, is improved so as to make the holes for seams of rivets in a perfect line, and with absolute accuracy of pitch.

With respect to the smith's shop, all large pieces of work are now manipulated under heavy Nasmyth or other steam hammers; while smaller pieces of work are commonly prepared either in forging machines or under rapidly moving hammers, and when needed in sufficient numbers are made in dies. And applicable to all the three industries of the fitting shop, the boiler shop, and the smith's shop, and also to that other industry carried on in the foundry, are the travelling and swing cranes, commonly worked by shafting, or by quick moving ropes for the travellers, and by hydraulic power or by steam-engines for the swing cranes. It may safely be said that, without the aid of these implements, it would be impossible to handle the weights that are met with in machinery of the present day.

I now come to one class of machine which, humble and small as it is, has probably had a greater effect upon industry and upon domestic life than almost any other. I mean the *Sewing machine*. In 1831, there was no means of making a seam except by the laborious process of the hand needle. In 1846, Eldred Walker patented a machine for passing the basting thread through the gores of umbrellas, a machine that was very ingenious and very simple, but was utterly unlike the present sewing machine, with its eye-pointed needle, using sometimes two threads (the second being put in by a shuttle or by another needle), and making stitches at twenty-fold, the rapidity with which the most expert needle-woman could work. By means of the sewing machine not only are all textile fabrics operated upon, but even the thickest leather is dealt with, and as a *tour de force*, but as a matter of fact, sheet-iron plates themselves have been pierced, and have been united by a seam no boiler-maker ever contemplated, the piercing and the seam being produced by a Blake sewing machine. I believe all in this Section will agree that the use of the sewing machine has been unattended by loss to those who earn their living by the needle; in fact, it would not be too much to say that there has been a positive improvement in their wages.

The next matter I have to touch upon is *Agricultural machinery*. In 1831, we had threshing machines and double ploughs, and even multiple ploughs had been proposed, tried, and abandoned. Reaping machines had been experimented with and abandoned; sowing machines were in use, but not many of them; clod crushers and horse rakes were also in use; but as a fact ploughing was done by horse power with a single furrow at a time, mowing and reaping were done by the scythe or the sickle, sheaves were bound by hand, hay was tedded by hand-rakes, while all materials and produce were moved about in carts and in waggons drawn by horses. At the present time we have multiple ploughs, making five or six furrows at a time, these and cultivators also driven by steam, commonly from two engines on the head lands, the plough being in between, and worked by

a rope from each engine, or if by one engine, a capstan on the other head land, with a return rope working the plough backwards and forwards; or by what is known as the round-about system, where the engine is fixed and the rope carried round about the field; or else ploughs and cultivators are worked by ropes from two capstans placed on the two head lands, and driven by means of a quick going rope, actuated by an engine, the position of which is not changed. And then we have reaping machines, driven at present by horses; but how long it will be before the energy residing in a battery, or that in a reservoir of compressed air, will supersede horse power to drive the reaping machine, I don't know, but I don't suppose it will be very long. The mowing and reaping machines not only cut the crop and distribute it in swathes, or, in the case of the reaping machine, in bundles, but now, in the instance of these latter machines, are competent to bind it into sheaves. In lieu of hand tedding, hay-making machines are employed, tossing the grass into the air, so as to thoroughly aerate it, taking advantage of every brief interval of fine weather; and seed and manure are distributed by machine with unfailing accuracy. The soil is drained by the aid of properly constructed ploughs for preparing the trenches; roots are steamed and sliced as food for cattle; and the threshing machine no longer merely beats out the grain, but it screens it, separates it, and elevates the straw, so as to mechanically build it up into a stack. I do not know a better class of machine than the agricultural portable engine. Every part of it is perfectly proportioned and made, it is usually of the locomotive type, and the economy of fuel in its use is extremely great. I cannot help thinking that the improvement in this respect which has taken place in these engines, and the improvement of agricultural machinery generally, is very largely due to the Royal Agricultural Society, one of the most enterprising bodies in England.

I now come to the very last subject I propose to speak upon, and that is *Printing machinery*, and especially as applied to the printing of newspapers. In 1831, we had the steam press sending out a few hundred copies in an hour, and doing that upon detached sheets, and thus many hours were required for an edition of some thousands. The only way of expediting the matter would have been to have recomposed the paper, involving, however, double labour to the compositors, and a double chance of error. At the present day, we have, by the Walter press, the paper printed on a continuous sheet at a rate per hour at least three times as great as that of the presses of 1831, and, by the aid of *papier maché* moulds, within five minutes from the starting of the first press, a second press can be got to work from the stereotype plates, and a third one in the next five minutes; and thus the wisdom of our senators, which has been delivered as late as three o'clock in the morning, is able to be transmitted by the newspaper train leaving Euston at 5.15 a.m.

This is the last matter with which I shall trouble the Section. I have purposely omitted telegraphy; I have purposely omitted artillery, textile fabrics, and the milling and preparation of grain. These and other matters I have omitted for several reasons. Some I have omitted becaus[e] incompetent to speak upon them, others bec[ause of] the want of time, and others because th[ey] properly belong to Section A.

I hope, sir, although your address, deali[ng with] the future, was undoubtedly the right add[ress for] a President to deliver, and although it is right that we should not content ourselv[es] merely looking back in a "rest and be th[ankful"] spirit at the various progress which thi[s] records, it may nevertheless be thought w[ell that] there should have been brought before the [Section,] in however cursory a manner, some n[otice of] mechanical development during the past fif[ty years.]

GENERAL NOTES.

Vienna Art Exhibition.—An International E[xhibition] of the chief works of art produced since the Exh[ibition of] 1873 will be opened at Vienna, by the Vienne[se Society of] Artists, on April 1, 1882, and continue open until Se[ptember] 30. The Exhibition will comprise architectural [designs,] models, paintings, engravings, and sculpture. A[ll works] intended for exhibition must be delivered at the K[ünstler]haus, Vienna, not later than March 1, 1882.

Patent Medicines.—According to a return jus[t issued,] the number of licenses to sell patent medicines t[aken out] during the year ending the 31st of March last wa[s ...,] for which there was paid the sum of £4,688 1[...]. [The] revenue derived from stamps for patent medicine[s during] the same time amounted to £139,762 18s. 10½d[., which] represented 17,198,442 stamps of different values.

"The Glow" Stove. — An open slow com[bustion] grate on a new principle has recently been pat[ented by] Messrs. Everitt and Barnard, and will be exhibite[d at the] Kyrle Society's Smoke Abatement Exhibition, to be [held at] the South Kensington Museum this month. The [fire,] as in all slow combustion stoves, is closed in; belo[w] the front are a number of holes, carrying a dra[ught] beneath and parallel with the surface upon which [the fuel] rests. These openings are connected with an air ch[amber at] the back of the grate, which chamber has an outle[t imme]diately over the fuel. A "Baffle" of fire brick, [...] the front and about an inch above the openings fro[m the] chamber, extends the full width of the stove, spring[ing from] the back at an angle of about 60°. The objects [of the] "Baffle," which becomes red-hot, are to form a com[bustion] chamber in which smoke is consumed, to accumu[late] heat which would otherwise escape up the chimney[, and to] throw the accumulated heat into the room.

MEETINGS FOR THE ENSUING WEEK

MONDAY, Nov. 7...Farmers' Club, Inns of Court Hotel, [...] W.C., 4 p.m. Mr. G. M. Allender, "Dairying." British Architects, 9, Conduit-street, W., 8 p.m.

TUESDAY, Nov. 8...Central Chamber of Commerce (at the [House] OF THE SOCIETY OF ARTS), 11 a.m.
Medical and Chirurgical, 53, Berners-street, W., 8.30 p.m.
Civil Engineers, 25, Great George-street, West[minster,] S.W., 8 p.m. Mr. Charles Wood, "Iron P[ermanent] Way."
Anthropological Institute, 4, St. Martin's-pla[ce, W.C.,] 8 p.m. 1. Mr. E. F. im Thurn, "The Anim[ism of the] Indians of British Guiana." 2. Mr. M. J. W[...,] "Some Vestiges of Girl Sacrifices, Jar Burial, [and Con]tracted Interments in India and the East."

WEDNESDAY, Nov. 9...Microscopical, King's College, W.C[., 8 p.m.] Mr. B. Wills Richardson, "Multiple Staining of [Animal] and Vegetable Tissues."

THURSDAY, Nov. 10...Mathematical, 22, Albemarle-stre[et, W., 8] p.m. 1. Annual Meeting. 2. Messrs. M. Je[...] C. W. Merrifield, "Note on the Limit to the [...] of Proper Fractions, &c." 3. Prof. H. Lam[b,] Oscillations of a Viscous Spheroid."

SATURDAY, Nov. 12...Physical, Science Schools, South K[ensington,] S.W., 3 p.m. 1. Mr. Lewis Wright, "S[...] Crystals." 2. Mr. C. V. Boys, "Integrating a[nd other] Apparatus for the Measurement of Elect[rical and] Mechanical Forces."

JOURNAL OF THE SOCIETY OF ARTS.

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FRIDAY, NOVEMBER 11, 1881.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

NOTICES.

PATENT LAW DISCUSSION.

The Discussion on the Society of Arts' Patent Bill will not be held on Wednesday, November 30, as previously announced, but on Friday, December 2nd.

The discussion will be opened by Sir FREDERICK BRAMWELL, F.R.S., Chairman of the Council, and will be continued on such evenings as may be found convenient.

The Secretary will be glad to furnish tickets for the meeting to persons interested in the subject of Patent Law who are not members of the Society.

ELECTRIC LIGHTING IN THEATRES.

Mr. R. D'Oyly Carte, the proprietor of the Savoy Theatre, in the Strand, has kindly made arrangements for Members of the Society, who may wish to do so, to inspect the lighting arrangements of the Savoy Theatre, on the afternoon of to-morrow (Saturday, the 12th of November), at ten minutes before five. Members will be admitted on presentation of their visiting cards. Each member may be accompanied by one friend.

EXHIBITION OF PHOTOGRAPHIC APPLIANCES.

In connexion with the course of Cantor Lectures, which will be delivered by Captain Abney, F.R.S., on "Recent Advances in Photography," in January and February next, it is proposed to hold, in the House of the Society of Arts, an Exhibition of Photographic Appliances.

The dates of Captain Abney's Lectures are January 30, February 6, 13, and 20. The Exhibition will be kept open from January 30 till about the end of February.

The Exhibition will be of a technical character, and it is not, therefore, desired to collect photographs of artistic merit only.

The following are among the principal classes of objects sought for exhibition:—

Apparatus: cameras, lenses, tents, instantaneous shutters, slides, sensitometers, lamps (intended specially for photographic purposes), enlarging apparatus, printing and mounting apparatus, &c.

Photographic materials.

Illustrations of new processes; negatives and prints produced by new or special processes.

Appliances used in reproductive processes; specimens of illustrations produced by such processes; specimens of historical interest, as illustrations of old processes.

Lighting: models illustrative of characteristic features in the construction of glass houses; methods of fixing glass without putty or similar material; arrangements for the production of artificial light for photographic purposes.

Any person wishing to exhibit any of the above is requested to communicate with the Secretary of the Society, who will supply printed forms of application for space, and will be glad to give any further information required.

It is hoped that arrangements may be made for showing the actual working of some of the more recent processes.

LABEL FOR PLANTS.

The Council, on the recommendation of the judges in the late competition of plant labels, are prepared to renew the offer of a Society's Silver Medal, together with a prize of £5, which has been placed at their disposal for the purpose by Mr. G. F. Wilson, F.R.S., for the best label for plants.

The object of the offer is to obtain a label which may be cheap and durable, and may show legibly whatever is written or printed thereon; the label must be suitable for plants in open border. These considerations will principally govern the award.

The award will be made on the recommendation of the Committee appointed for the purpose by the Council.

Specimen labels, bearing a number or motto, and accompanied by a sealed envelope containing the name of the sender, must be sent in to the Secretary of the Society, not later than the 1st May, 1882.

The Council reserve to themselves the right of withholding medal and prize offered, if, in the opinion of the judges, none of the specimens sent in are deserving.

ARRANGEMENTS FOR THE SESSION.

The first meeting of the One Hundred and Twenty-eighth Session of the Society will be held on Wednesday, the 16th inst., when the Opening Address will be delivered by Sir FREDERICK J. BRAMWELL, F.R.S., Chairman of the Council, and the Medals awarded during the last Session will be presented. Previous to Christmas, there will be four ordinary meetings in addition to the opening meeting.

Candidates proposed for election as members are privileged to attend the opening meeting.

ORDINARY MEETINGS.

The following arrangements for the Wednesday evenings before Christmas have been made:—

NOVEMBER 16.—Opening Meeting of the Session. Address by Sir FREDERICK J. BRAMWELL, F.R.S., Chairman of the Council.

NOVEMBER 23.—"The Storage of Electricity." By Prof. SYLVANUS THOMPSON, D.Sc.

NOVEMBER 30.—"The Distribution of Time by a System of Pneumatic Clocks." By J. A. BERLY.

DECEMBER 7.—"The American System of Heating Towns by Steam." By Capt. DOUGLAS GALTON, C.B., F.R.S.

DECEMBER 14.—"Electric Lighting at the Paris Electrical Exhibition." By W. H. PREECE, F.R.S.

At the meetings after Christmas, the following papers (among others) will be read:—

"Practical Hints on the Manufacture of Gelatine Emulsions and Plates for Photographic Purposes." By W. K. BURTON.

"Stained Glass Windows." By LEWIS FOREMAN DAY.

"Photometric Standards." By HAROLD DIXON.

"Telephonic Communication." By LIEUT.-COL. C. E. WEBBER.

"The Causes and Remedies of Bad Trade." By WALTER R. BROWNE, M.A.

"The Native Tribes of the Hudson's Bay Territories." By DR. RAE, F.R.S.

"The Manufacture of Ordnance." By COLONEL MAITLAND.

"Some Practical Aspects of Recent Investigations in Nitrification." By R. WARINGTON.

"The Production and Use of Gas for Purposes of Heating and Motive Power." By J. EMERSON DOWSON.

"Gas for Lighthouses." (Illustrated by an exhibition of some of the gas flames and apparatus used in lighthouses.) By JOHN WIGHAM.

"The Relation of Botanical Science to Ornamental Art." By F. EDWARD HULME, F.L.S., F.S.A.

"The High-pressure Steam-engine." By LOFTUS PERKINS.

"The Industrial Resources of Ireland." By G. PHILLIPS BEVAN.

"A New Antiseptic Compound, and its Application to the Preservation of Food." By PROF. BARFF, M.A.

"Tonnage Measurement." By ADMIRAL SIR R. SPENCER ROBINSON, K.C.B., F.R.S.

"Tools and Cutting Edges." By D. A. AIRD.

"The Teaching of Forestry." By COLONEL G. PEARSON.

"The Art of Turning." By P. W. HASLUCK.

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take pl[ace] on the following Tuesday Evenings, at Ei[ght] o'clock:—

January 31; February 28; March 21; April 4, [...] May 23.

APPLIED CHEMISTRY AND PHYSICS SECTION.

The meetings of this Section will take pl[ace] on the following Thursday Evenings, at Ei[ght] o'clock:—

January 26; February 23; March 9, 30; April [...] May 11.

INDIAN SECTION.

The meetings of this Section will take pl[ace] on the following Friday Evenings, at Ei[ght] o'clock:—

February 17; March 17, 31; April 21; May 12, [...]

CANTOR LECTURES.

The First Course will be on "Some of [the] Industrial Uses of the Calcium Compounds." [By] THOMAS BOLAS, F.C.S.

November 21, 28; December 5, 12.

The Second Course will be on "Recent Advan[ces] in Photography." By CAPT. ABNEY, R.E., F.R.S.

January 30; February 6, 13, 20.

The Third Course will be on "Hydra[ulic] Machinery." By PROF. JOHN PERRY.

March 6, 13, 20, 27.

The Fourth Course will be on "Book Illus[tra]tion, Old and New." By J. COMYNS CARR.

April 20; May 1, 8, 15.

Syllabus of the First Course.

LECTURE I.

Distribution and occurrence of calcium in nat[ure]. Carbonate of lime as limestone, chalk, marble, calc[areous] shells, &c. Notes on some of the calcium mine[rals]. Short survey of the chemistry of calcium and c[...] derivations.

LECTURE II.

Lime. The calcination of the carbonate in th[eory] and practice. Influence of foreign bodies on [the] quality of the lime. Most favourable conditions fo[r the] decomposition of pure and impure forms of cal[cium] carbonate. Cements and their uses. Lime [as a] refractory material. Lime-light. The oxyhydr[ogen] furnace. Lime moulds for the casting of iron [and] steel. Notes on a few of the industrial and econ[omic] uses of lime.

LECTURE III.

Sulphate of lime and its occurrence in nature. Gypsum and alabaster. Plaster of Paris, its preparation and uses. Physical and chemical aspects of the setting of plaster. Accelerating and retarding influences. Scientific principles involved in some of the applications of plaster. Moulding, stereotyping, and other processes.

LECTURE IV.

Other calcium compounds and their uses. The phosphorescent sulphide. Lime soaps. Bleaching powder. Phosphates of calcium. Organic calcine salts. The hardness of water, &c.

JUVENILE LECTURES.

The two Juvenile Lectures will be by W. H. PREECE, F.R.S., on "Recent Wonders of Electricity." The dates for these are Wednesday evenings, December 28 and January 4. The Lectures will commence at 7 o'clock.

Special tickets will be issued for these lectures, due announcement of which will be made.

ADMISSION TO MEETINGS.

Members have the right of attending all the Society's meetings and lectures. They require no tickets (except for the Juvenile Lectures), but are admitted on signing their names. Every Member can admit *two* friends to the Ordinary and Sectional Meetings, and *one* friend to the Cantor Lectures. Books of tickets for the purpose have been issued to the Members, but admission can also be obtained on the personal introduction of a Member.

ANNUAL GENERAL MEETING.

The Anuual General Meeting will be held on Wednesday, June 28, at four o'clock.

The following is a table of dates of the Evening Meetings of the Society, subject to such alteration as may be found necessary:—

	CANTOR LECTURES.	FOREIGN AND COLONIAL MEETINGS.	ORDINARY MEETINGS.	APPLIED CHEMISTRY AND PHYSICS MEETINGS.	INDIAN MEETINGS.
	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.
1881.					
NOVEMBER	— — 21 28 —	— — — —	— — 16 23 30	— — — —	— — — —
DECEMBER	5 12 — — —	— — — —	— 7 14 — —	— — — —	— — — —
1882.					
JANUARY	— — — — 30	— — — 31	— 11 18 25 —	— 26 — —	— — — —
FEBRUARY	6 13 20 — —	— — 28 —	1 8 15 22 —	— 23 — —	— — 17 —
MARCH	6 13 20 27 —	— — — 21	1 8 15 22 29	9 — — 23	— 17 — 31
APRIL	— — — 24 —	— 4 — 25	— 19 26 — —	— 27 — —	— 21 — —
MAY	1 8 15 — —	— — 23 —	3 10 17 24 31	4 — — —	12 — — 26

THE CHAIR WILL BE TAKEN AT EIGHT O'CLOCK AT EACH OF THE ABOVE MEETINGS.

MISCELLANEOUS.

THE CULTIVATION OF THE RAMEH PLANT.

The rameh plant possesses qualities and merits of the highest value for textile industries, and in the whole of Europe, Consul Stanton states, that France alone has attempted the industrial development of this Chinese plant, and the attempt has met with such success as to give that country a decided advantage over other European manufacturing countries. At the present time the cultivation makes great progress in Southern France, Corsica, and Algiers, and a practical process has lately been discovered for separating the fibres from the stems. The plant belongs to the nettle family, and although stingless, is similar to the stinging nettle in the form both of its leaves and branches, having, however, a much more luxuriant growth. The branches grow straight, and in bunches, and are composed of a brittle, woody substance, filled with pith, and surrounded with a fibrous covering which, in its turn, is covered with a thin skin or rind. The fibres are bound together by a resinous substance, which is more difficult to dissolve than that contained in flax and hemp, and from this circumstance the setting of the rameh plant is more laborious than hemp and flax, though the hackling of the stems is less arduous. The propagation of the plant may be effected by seeds, layers, or cuttings; but as the reproduction from seeds is generally slow and uncertain, slips and layers are more often used. The rameh is a perennial, and not like flax and hemp, an annual, and its strength and fertility increases with its age; it withstands both drought and damp, but is very susceptible to frost. Even after frost, however, it is only the first crop which is lost, since the roots, which penetrate the ground to a depth of about a foot, are seldom affected, and soon put forth new shoots. Its growth is unusually rapid, and even in France it attains annually a height of from six to eight feet. In its home, however (China and Bengal), it attains the height of 15 feet. By cutting the stems when they have attained a height of three feet, several crops and finer fibres are obtained, the plant renewing its shoots continually. The leaves, when dried, are valuable for the manufacture of the tough paper which is so e

tensively used in China, while the green ones afford excellent cattle fodder. On account of its luxuriant growth, extensive manuring is requisite; and, with the exception of this manuring, and the careful manner in which it must be done, the cultivation of the rameh is of the simplest kind, and with due care for frost, it may be planted at any season. The planting is generally in furrow, ten inches deep, and a yard apart, the plants being set out at intervals of a yard. Hoeing and digging are only necessary the first year, the plant growing afterwards with such luxuriance as to smother all weeds. In the spring, and after each cutting, hoeing is generally resorted to; and if, at the approach of winter, the earth is heaped up round the roots, to protect them from frost, the branches increase rapidly in number, the first growth yielding from three to four, the second from six to eight, the third from ten to twelve, and the fourth (this, however, is only in warm climates), from sixteen to twenty branches. The pecuniary results so far obtained, are most satisfactory. It is maintained that the rameh plant will yield a crop worth from £56 to £80 per hectare (2·47 acres); and assuming that three cuttings are annually obtained, there would be a yield of from 4,000 to 5,000 kilos. of leaves alone, which would cover all the expenses of cultivation. In addition to this, there would be from 1,500 to 2,200 kilos. of fibres, from which 1,200 to 1,500 kilos. of white linen could be spun. The tenacity of the rameh fibre is 30 per cent. greater than that of flax, and in consequence of this tenacity, it has for many years been used in China in the manufacture of many articles, in which solidity is absolutely necessary. In China from fibres of this plant the coarsest nets are woven, and fabrics which surpass in gloss and delicacy the finest battiste. As with flax and hemp, the first operation is to separate the fibres from the resinous substance which unites them; this is effected by steeping in water. The Belgians have recently substituted for the old plan, a new, more rapid, and healthier process, which produces an excellent commercial result. Large square cemented vats are used; in these the branches are laid, then water is poured on and kept, for flax and hemp, for one or two days, and for rameh from five to six days; to the water one-half per cent. of the weight of the branches, of pulverised charcoal is added, and the same quantity of carbonate of soda or potash, and throughout the process the vats are kept carefully closed. In this manner decomposition takes place slowly, and the fibres are protected from the injurious effects of the exhalations of sulphureted hydrogen. After the gluten is dissolved from the fibres, they have only to be separated from the woody tissue; this is effected by hackling, which was formerly slowly and arduously done by hand, but is now performed by machinery in a very simple manner. The branches are passed successively through four pairs of rollers, which destroy the woody tissue; then the hackling done by two pairs of grooved cylinders, which, by a movement backwards and forwards, rub and cleanse the fibres from all impurities; a third machine, which consists of a hollow cyclinder inclosing an axle, does the combing. This axle is provided with a number of whips, which beat the fibres continually; the fibres enter the cylinder at an opening in the side, the dust is removed by a ventilator, and the branches reduced to the finest fibres, leave the machine perfectly cleansed, and after bleaching are ready for spinning. In consequence of the silky character of the fibre, it is necessary to fasten the warp securely to prevent its being pulled out when weaving. Special attention is also paid to the dyeing to ensure fast colours. In France, measures have been taken for the manufacture of elegant rameh stuffs on a large scale, either from rameh for table-cloths, and furniture coverings, or mixed with wool and silk for draperies, and it is the opinion of those engaged in the manufacture of textile fabrics that the time has arrived when this material will play a great rôle in textile industries.

CORRESPONDENCE.

PISTACHIA GUM.

Some time ago I read in your *Journal* (vol. xxix., p. 596), that Mr. Thos. Christy, F.L.S., offered to supply any of your readers with samples of a new gum called *Pistachia terebinthus*, so that its value as an article of commerce might be tested. Having procured a sample of this gum, I will now, if you have space to spare in your valuable *Journal*, give you a few particulars as to my experiments with it, which will prove, in my opinion, its future commercial value.

This new gum, which is soluble in oil, turpentine, and alcohol, is of a light yellowish colour, and has an agreeable odour of mastic.

If the Pistachia gum is mixed with common resin, soda of a strength of 25 degrees has no soluble action on the gum, and soda of a strength even far greater than 25 degrees has, no more than water, any effect on the unadulterated Pistachia gum. These facts alone are a sufficient proof of the value of this gum for the uses to which I have subjected it in my experiments.

It is well known that most of the gums or resins now used in the manufacture of varnish are soluble in soda, and therefore yield to the action of soap in a short space of time. Now, the varnish made with Pistachia gum possesses many advantages over the ordinary varnish, for, besides being waterproof, it does not in any way yield to either the action of soap or soda, and it can also be advantageously used for oilcloth.

I found, after further experiment, that when left in contact with the open air, this new varnish thickens very quickly, which renders it a valuable acquisition to painters on glass and porcelain, both as a substitute for the burning process, or to mix with the colours now used.

The colour of this varnish can be made of different shades, varying from a light grey to a beautiful dark brown, and it has the same appearance as the ordinary varnish. Pistachia gum, while of a similar character and of the same basis as Venetian turpentine, is far more important in its composition, which ought to render it valuable for commercial and medicinal purposes, and I may add, in conclusion, that *Pistachia terebinthus* gum, as a varnish and paint, in my opinion will become in the future of great value for these purposes.

JULES GRETZ.

Ponder's-end.

SCIENCE TEACHING IN SCHOOLS.

The following may interest the readers of the Society of Arts' *Journal*, as affording a practical illustration of the ease with which the elementary scientific notions that have the most direct bearing on daily life, may be introduced in the schools of the people.

The views I had long entertained concerning the introduction of useful knowledge in the education of the masses, received in 1870 much encouragement from the adoption, by the London School Board, of Dr. Gladstone's plan for initiating, at an early age, by experimental as well as visual means, elementary notions about Common Things, and disseminating practical germs of thoughtful cleverness. I naturally became anxious to show how conveniently the materials for progressive lessons in physics, chemistry, and physiology, contained in my "Science made Easy" Course of ten lectures, might serve for developing in the successive standards of primary schools knowledge conducive to health, common sense, and industrial success. In order to indicate how this might be done most effectually, I invited the teachers of both sexes of the Metropolitan Board Schools to attend, in the beginning

of 1880, a special delivery of the course. By permission of the head-master, Dr. Wormell, it was given at the Middle-Class Schools in Cowper-street, where a full collection of my apparatus and diagrams was in constant use by Mr. J. Bower, one of the science masters, who added appropriate pedagogic remarks and advice. The attendance of the teachers was numerous, and their satisfaction very encouraging, as was also the manner in which a considerable number of them passed a special examination held on the so-called "open-handed" system.

My next step was to place a collection of "Science made Easy" apparatus and diagrams at the disposal of the London School Board, for being circulated seriatim, by way of experiment, to seven Board schools in various parts of the metropolis, duly supplied with copies of the ten lectures, and with "Suggestions" in a pamphlet form, for their adaptation to juvenile instruction. Each school in its turn has the use of a lecture-box for at least a fortnight, at the end of which term the multifarious contents are inspected by my special agent, cleaned, replenished and packed for being transmitted to the school next on the list. The scheme may seem an intricate one, but it is progressing admirably, thanks to the intelligent management of my secretary, who, from the Economic Museum, directs each detail of the proceedings; and to the exemplary promptness and regularity with which the Stores Department of the School Board effects the transfer of the boxes from school to school.

Though the experiment is not yet entirely completed, it has become evident that, should the London School Board be inclined to follow up the system thus initiated, a comparatively limited number of "Science made Easy" sets would suffice to meet the requirements of the chief schools of the metropolis. They might be supplied by Messrs. Griffin, of Garrick-street, Covent-garden, who have lately completed a pattern set for the American Government, and who would contract for the periodical inspection and renovation at a charge which, according to my experience, would be moderate. A far more important point, however, is the satisfaction with which the masters appear to dispense this practical instruction, and the pleasure with which the children appear to receive it. I cannot do better than quote on this score a letter just received from the head master of one of the schools, which, being among the first on the list, has completed the use of the course:—

"The masters (including myself) liked the lessons very much, and the boys looked forward to them, so much so, that we had the highest attendance on the days the lessons were given, and it was considered a severe punishment to be sent into another room, and thus lose the science lessons. . . . . Thanking you very much for the opportunity you have placed in my way of having pleasing, useful lessons, so admirably illustrated, given in my school, I remain, yours, &c."

It is essential to make a clear distinction between a system of *connected* and progressive lessons, carefully selected with a view to practical utility, from the general range of natural science, and the plan which has hitherto prevailed, of teaching *detached* branches of science as "special subjects," with a view, perhaps, rather to the best chances of pecuniary results, than to the prospective occupations, and consequent requirements of the children. Special attainments in science and art need not be excluded in the highest standards, but they are best acquired in that secondary instruction to which so much attention is being devoted, among the more enlightened of the industrial communities of the Continent, and which amongst us is mainly represented by Evening Classes. This secondary instruction in science should diverge freely into the various channels of industrial employment. Primary science, on the contrary, whilst it should serve as a general foundation to special secondary attainments, should at the same time consist of information directly meeting the requirements of Daily Life; it should, in fact, precisely teach that knowledge which everyone ought to possess; and, accordingly, making allowance for certain natural distinctions of sex, and for a few differences depending on local circumstances, or deficient resources it should be *obligatory* and *uniform*. It should be moulded on an official programme, prepared by thoroughly competent educationalists, which would indicate, with elastic outlines, the course to be pursued, and supply alternatives for abnormal circumstances.

T. TWINING.

Twickenham.

BOILERS OF KITCHENERS.

As householders are now beginning to look forward to the winter with its consequent frosts, and as the old-fashioned kitchen ranges are being entirely superseded by the modern kitchener, it seems to me very desirable that the use of these should be properly and thoroughly understood. I find that in the ordinary dwelling houses now being built, or those of recent construction, the *double oven* kitchener is the most frequently used, and this has the boiler placed at the back of the range, and out of reach of the ordinary members of the household.

In addition to the impracticability of getting at this to clean it—a very important *dis*-advantage—there seems, in the event of a sudden and sharp frost, great danger of its bursting, if the pipes leading to and from the same to the hot-water supply should by any means become frozen.

There ought to be, and no doubt is, some simple and economical device that could be adapted to these kitcheners (without having to take out and re-set them), did but the ordinary householder know it, and it is on this ground I write, feeling sure that the insertion of this letter in the Society's *Journal* will induce some of its members to suggest a remedy, and enable every householder, so disposed, to avail himself of such suggestion, and to sleep peacefully in his bed without the fear haunting him of being suddenly blown out of it some frosty morning; and at the same time render him free from any anxiety of finding his domestics the victims of the new and, at present, imperfectly understood substitutes for the old open kitchen ranges.

F. B. W.

NOTES ON BOOKS.

Technical Vocabulary (English-French) for Scientific, Technical, and Industrial Students. By D. F. J. Wershoven. (London: Librarie Hachette et Cie. 1881.)

The words and phrases given in this book are arranged under the great headings of physics and mechanics, chemistry and metallurgy, machinery and manufactures, and an index of English words affords the reader an easy key to the classification. A list of the Latin, French, English, and German names of timber trees is added.

Reports on the Estate of Sir Andrew Chadwick, and the recent proceedings of the Chadwick Association in reference thereto, by Edmund Chadwick and James Boardman. To which is prefixed the Life and History of Sir Andrew Chadwick, by John Oldfield Chadwick. (London: Simpkin, Marshall, and Co. 1881.)

Sir Andrew Chadwick died in the year 1768, at the age of 84, leaving a considerable property, the [illegible] of which has given rise to a large amount of [illegible]

Mr. J. O. Chadwick has described fully the various incidents connected with the carrying out of the will and its numerous codicils, and has also given an account of the early history of the Chadwicks.

GENERAL NOTES.

Manufacturers' and Mill Owners' Mutual Aid Association.—An Association has been incorporated by Act of Parliament, 1881, under this title, for the purpose of facilitating, as far as manufactories and mills are concerned, the objects proposed by the Act of 1876, for preventing the pollution of rivers, and also for the utilisation of waste products. The secretary (*pro. tem.*) is Mr. J. Breeze, and the office is at No. 5, The Sanctuary, Westminster, S.W.

Canadian Fisheries.—The supplement to the report of the Minister of Marine and Fisheries for 1880-81 contains much information relating to the value of the fisheries of Canada. The total value of the catch in the Provinces amounted to 14,500,000 dollars, in 1880 and to 13,529,250 dollars in 1879, an increase for the past year of nearly 1,000,000 dollars. The following statement shows the value of the yield of each of the principal varieties of fish:—

	Dols.		Dols.
Cod	4,534,000	Mackerel	2,178,966
Salmon	645,427	Herrings	1,511,012
Haddock	406,075	Lobsters	2,143,312
Whitefish	203,018	Trout	134,897

The codfish is obtained chiefly in Novia Scotia, where the yield reached 2,497,839 dollars, and in the Gulf of St. Lawrence, within the Province of Quebec, where it was 1,628,000 dollars. Mackerel and haddock are obtained most largely in Nova Scotia; herrings in New Brunswick; lobsters in New Brunswick, Prince Edward Island, and Nova Scotia; salmon in British Columbia; and trout and whitefish in Ontario.

South African Diamonds.—According to *The Colonies and India*, the gross weight of diamonds contained in packages passed through the Kimberley post-office, in 1880, was 1,440 lbs. 12 oz. avoirdupois, the estimated value being £3,367,897. These figures compare with 1,174 lbs. and £2,846,631 in 1879; 1,150 lbs. and £2,672,744 in 1878; 903 lbs. and £2,112,427 in 1877; and 773 lbs. and £1,807,532 in 1876. The annual value of the mines in the Kimberley division owned at the end of 1880 by the Government and the London and South African Exploration Co. is estimated as follows:—Kimberley, £4,000,000; Old De Beer's, £2,000,000; Du Toit's Pan, £2,000,000; Bullfontein, £1,500,000. At the end of last year 22,000 black and 1,700 white men were employed at these mines. From the Kimberley and Old De Beer's mines alone diamonds to the extent of 3,200,000 carats are annually raised, while the other two mines above named yielded 300,000 carrats last year. At the diggings on the Vaal River about 250 men were at work last year. The other important mining industries of the Colony are the copper mines of Namaqualand, from which last year 15,310 tons of copper were exported, valued at £306,790. From the manganese mines in the Paarl division, 206 tons were exported; while at the coal mines in the Wodehouse and Albert divisions about 1,000 tons were raised. The salt-pans in Simon's Town, Malmesbury, Piquetberg, Fraserburg, Uitenhage, and Cradock yielded about 9,000 tons of salt. Mineral springs abound in the Colony, many of them being well resorted to, but accommodation for visitors is, as a rule, indifferent.

THE LIBRARY.

The following works have been presented to the Library:—

An Outline History of the Hanseatic League, more particularly in its bearings upon English Commerce. By Cornelius Walford, F.S.S. (London: Printed for private circulation, 1881.) Presented by the Author.

Plan to Liquidate the National Debt with less than the Cost of Interest. By Frederick N. Newcome. (London: Effingham Wilson.) Presented by the Author.

Ludgate-hill: Past and Present. By W. P. Treloar (London: Griffith and Farran, 1881.) Presented by the Author.

Science for All. Vol. iv. Edited by Robert Brown, M.A., Ph.D. (London: Cassell, Petter, Galpin, and Co., 1881.) Presented by the Publishers.

Reports on the Estate of Sir Andrew Chadwick and the recent proceedings of the Chadwick Association, by Edmund Chadwick and James Boardman, to which is prefixed the Life and History of Sir Andrew Chadwick, by John Oldfield Chadwick, F.S.S. (London: Simpkin, Marshall, and Co., 1881.) Presented by the Author.

Technical Vocabulary (English-French) for Students. By Dr. F. J. Wershoven. (London: Hachette and Co., 1881.)

Birmingham Inventors and Inventions. By Richard B. Prosser. (Birmingham: "Journal" Printing Works, 1881.) Presented by the Author.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, Nov. 14...Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Opening Address by the President, Mr. Edward Ryde.
Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. Opening Meeting of the Session.
Society of Chemical Industry, Burlington-house, W., 8 p.m. 1. Address by the Chairman, Prof. Abel. 2. Dr. Messel, "The Want of Uniformity in Tables of Specific Gravity."

TUESDAY, Nov. 15...Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Discussion on Mr. Wood's paper, "Iron Permanent Way."
Statistical, Somerset-house-terrace, Strand, W.C., 4 p.m. Opening Address, on the Land Question, by the President (Mr. J. Caird).

WEDNESDAY, Nov. 16...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Opening Meeting of the Session. Address by Sir Frederick J. Bramwell (Chairman of the Council).
Institute of Bankers (in the Theatre of the London Institution, Finsbury-circus, E.C.), 7 p.m. Mr. Rowland Hamilton, "Money and Barter."
Meteorological, 25, Great George-street, S.W., 7 p.m. 1. Mr. G. J. Symons, "The Gale that passed across the British Isles, October 13th and 14th, 1881." 2. Mr. J. Wallace Peggs, "The Structural Damage caused by the Gale as indicative of Wind Force." 3. Mr. C. N. Pearson, "The Meteorology of Mozufferpore, Tirhoot, 1880."
Geological, Burlington-house, W., 8 p.m. 1. Principal J. W. Dawson, "Notes on *Prototaxites* and *Pachytheca* from the Denbighshire Grits of Corwen, North Wales." 2. Dr. Henry Hicks, "Additional Notes on the Land Plants from the Pen-y-glog Slate-quarry, near Corwen, North Wales." 3. Mr. E. E. Berry, "Analysis of the Rocks from the Charnwood-Forest District." Communicated, with Notes, by Prof. T. G. Bonney.
Archæological Association, 32, Sackville-street, W., 8 p.m. Opening Meeting of Session. 1. Prof. Haytor Lewis, "The Boorg es Ziffir, Cairo." 2. Mr. Gordon M. Hills, "The Measurements of Ptolemy in Relation to the Western Portion of Britain."

THURSDAY, Nov. 17...Royal, Burlington-house, W., 4.30 p.m.
Linnean, Burlington-house, W., 8 p.m. Sir John Lubbock, "The Sense of Colour among some of the Lower Animals." 2. Mr. C. B. Clarke, "A Hampshire Orchis not Figured in English Botany." 3. Prof. T. S. Cobbold, "New Entozoon from the Ostrich." 4. Mr. R. Irwin Lynch, "A Contrivance for Cross Fertilisation in *Roscoea purpurea*." 5. Sir John Lubbock, "Observations on Ants, Bees, and Wasps." Part IX.
Chemical, Burlington-house, W., 8 p.m. 1. Dr. Gladstone and Mr. Tribe, "Aluminium Alcohols: their Products of Decomposition by Heat." 2. Mr Wethered, "The Chemical Action of Decomposing Vegetable Matter on the Rich Forming Sediment of the Carboniferous Period.

CONTRIBUTIONS TO THE READING-ROOM.

The Council beg leave to acknowledge, with thanks to the Proprietors, the regular receipt of the following Transactions of Societies and Periodicals during the year:—

TRANSACTIONS, &c.

Aeronautical Society, Annual Report.
Amateur Mechanical Society, Journal.
American Chemical Society, Journal.
American Society of Civil Engineers, Transactions.
Art Union of London, Report.
Bayerische Dampfkessel-Revisions-Verein, Bayerisches Industrie-und-Gewerbeblatt.
British Association for the Advancement of Science, Report.
British Association of Gas Managers, Report of the Proceedings.
British Horological Institute, Journal.
Charity Organisation Society, Reporter.
Chemical Society, Journal.
Colonial Institute, Proceedings.
East India Association, Journal.
Farmers' Club, Journal.
Franklin Institution, Journal.
Geological Society, Journal.
Geologists' Association, Proceedings.
Glasgow Philosophical Society, Poceedings.
Index Society, Publications.
India, Geological Survey of, Memoirs, Records, and Palæontologia Indica.
Indian Meteorological Memoirs.
Institute of Bankers, Journal.
Institution of Civil Engineers, Minutes of Proceedings.
Institution of Civil Engineers of Ireland, Transactions.
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